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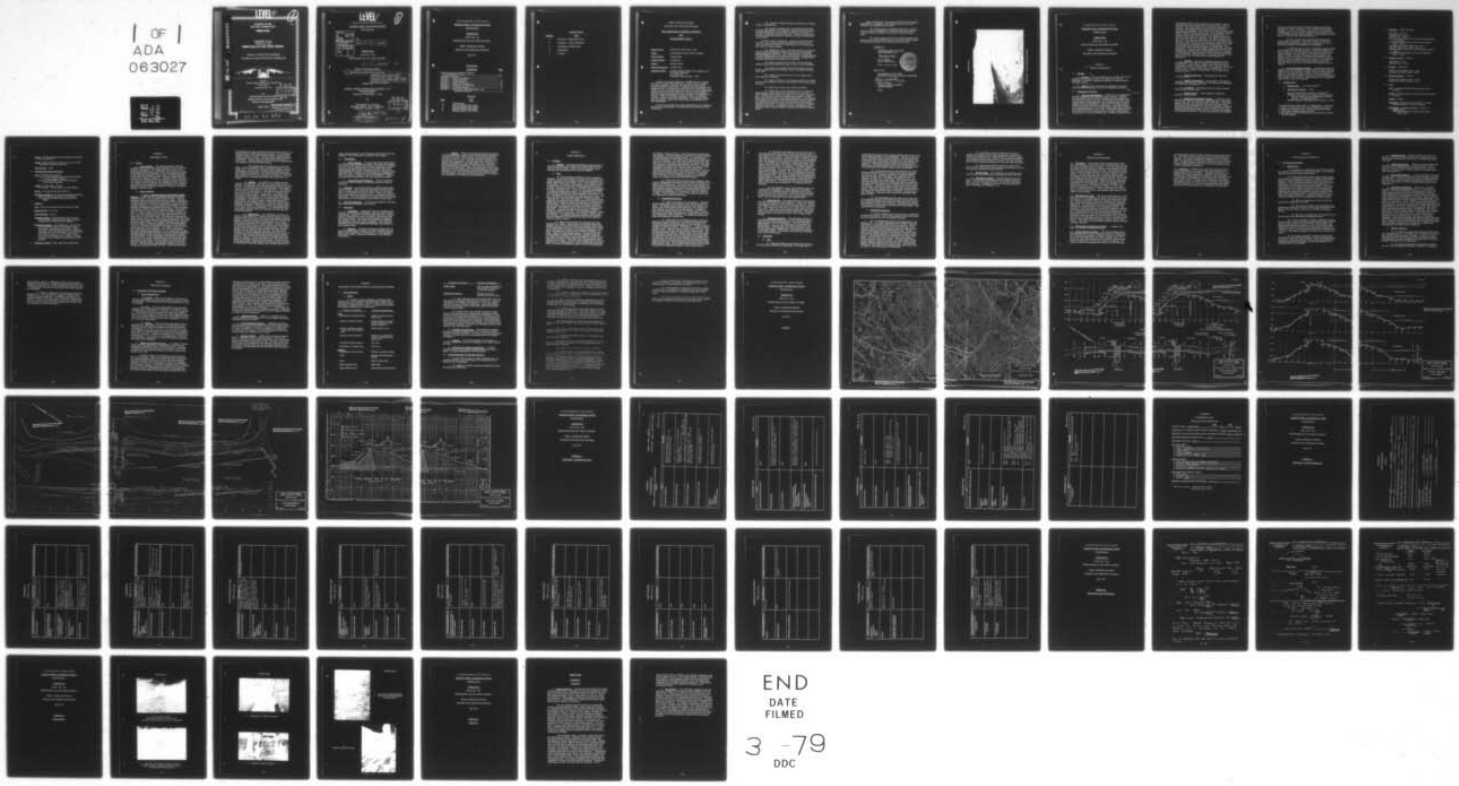

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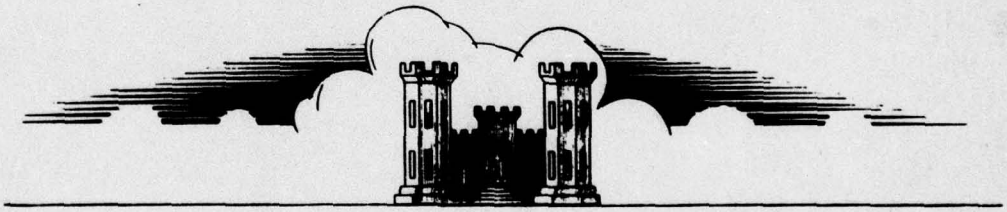
SUSQUEHANNA RIVER BASIN
LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM
NDS ID NO. 188
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MAY 1978

LEVEL II

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

(15) DACW-31-78-C-0046

GRIFFIN DAM

NDS ID No. 188

PENNSYLVANIA GAS AND WATER COMPANY

(10) A. C. Hooke

PHASE I INSPECTION REPORT

(6) NATIONAL DAM INSPECTION PROGRAM.

Pennsylvania Gas and Water Company.
Griffin Dam (NDS ID Number 188).
Susquehanna River Basin, Leggetts Creek,
Lackawanna County, Pennsylvania. Phase
I Inspection Report.

Prepared by

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For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Griffin Dam (NDS ID No. 188)
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Leggetts Creek
Date of Inspection:	24 April 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, Griffin Dam is judged to be in fair condition. However, the spillway will not pass the Probable Maximum Flood (PMF) or one-half of the PMF without overtopping the dam. If Griffin Dam should fail due to overtopping, the hazard to loss of life downstream from the dam would be significantly increased from that which would exist just prior to overtopping. Based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 26 percent of the PMF peak inflow.

In view of the concern for safety of Griffin Dam, the following measures are recommended to be undertaken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Griffin Dam.

(2) Perform a detailed study for remedial work to meet hydraulic deficiencies of the spillway. Make field investigations to obtain dimensions and foundation conditions of structures as required to determine structural stability. Perform a detailed study for any remedial work required to meet any structural deficiencies of structures.

In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Operate the valves on the gated outlets to their fully open position periodically to ensure that they will be functional during emergency conditions. The usual practice is to open the blowoff discharge line in late winter during periods of high discharge to clean sediment from the bottom of the reservoir. Lubricate the operating mechanisms and repair access facilities.

(2) Remove stumps from the slope of the downstream earthfill section and remove trees that are close to toe of earthfill.

(3) Place a good quality riprap on the slope of the upstream earthfill section as required to ensure full slope protection top of dam.

(4) Monitor the downstream face of the spillway and make repairs as necessary.

(5) Repair or replace the deteriorated mortar in the joints in the masonry spillway wall and in the joints in the masonry gravity structure.

(6) Repair dry masonry wall at right of spillway.

(7) Install five or more observation wells, or other instrumentation, downstream of the axis of the dam. One well, or other instrumentation, should be located in the vicinity of each wet area. The other two should be at appropriate locations to determine general water level in downstream embankment. Data collected from observation wells and other instrumentation should be utilized in evaluating the stability of the structure and assessing piping potential in the future. Continue to observe wet areas and seepage downstream from dam. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

Before remedial work, that corrects structural and hydraulic deficiencies, is complete, the following measures are recommended to be undertaken by the Owner:

(1) During periods of unusually heavy rains, provide round-the-clock surveillance of Griffin Dam and have available a crew to clean the spillway of any debris which may collect there.

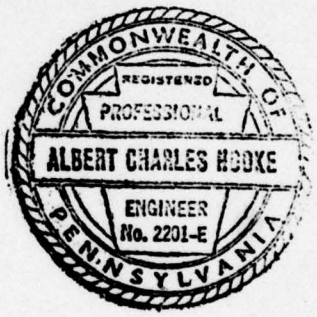
(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date: June 16, 1978



Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date:

GRIFFIN DAM

Griffin Dam — View from Right Abutment

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Griffin Dam is a combination earthfill embankment and masonry gravity structure. Earthfill has been placed against both the upstream and downstream faces of the masonry gravity structure. The downstream top edge of the masonry gravity nonoverflow structure projects beyond the downstream face of the embankment. The top of the masonry structure is about 2 feet below the top of embankment. The upper portion of the downstream face of the masonry gravity structure is exposed for a vertical distance of 4 to 9 feet. The earthfill upstream of the downstream edge of the masonry gravity structure slopes upward to top of dam. On the downstream side, earthfill is located below

-1-

the exposed portion of the masonry gravity structure. The exposed portion of the masonry gravity structure has a length of 340 feet. The overall length, into the earthen abutments, is unknown. The lowest elevation along the top of the dam is 40 feet above streambed. The 20-foot long spillway is positioned near the middle of the axis of the dam. It is a stepped, masonry gravity structure with earthfill against the upstream face. A masonry intake structure is located at the upstream side of the dam just to the right of the spillway. The intake structure contains a 30-inch cast-iron inlet with valve that discharges into a wet well. Discharge from the wet well is by a valve and 30-inch cast-iron outlet. The outlet line runs through the masonry spillway section and discharges at the toe of the spillway. The 30-inch line serves as both emergency or blowoff line and water supply line. An 8-inch water supply siphon runs along the spillway approach channel and down the stepped portion of spillway. A public road runs along the top of dam and crosses the spillway on a small bridge. Various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on Leggetts Creek approximately 1-1/2 miles northeast of Interstate Highway 81, at Chinchilla, Pennsylvania. Griffin Dam is shown on USGS Quadrangle, Scranton, Pennsylvania, with coordinates N41°29'45" and E75°39'55" in Lackawanna County, Pennsylvania, and is 6 miles north of Scranton, Pennsylvania. The location map is shown on Plate 1.

c. Size Classification. Intermediate (40 feet high, 2,581 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Griffin Dam (Paragraph 5.1.e.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for vicinity of Scranton, Pennsylvania.

g. Design and Construction History. At the site of the present dam there was originally a timber crib dam, constructed prior to 1861, that was used to operate Griffin Mill. The present masonry structure was apparently built over the timber crib in 1887-1888 by the Providence Gas and Water Company. The same company re-built the dam (to an unknown extent) in 1893-1895. No plans of the original timber structure or the later re-buildings were available for review. The dam was acquired by the present

Owner, as the Scranton Gas and Water Company, about 1900. The spillway crest was raised, by the Scranton Gas and Water Company, 1.5 feet in 1901 and 2.0 feet in 1910. The earliest available plans for any of these modifications were made in 1912 by the Scranton Gas and Water Company. These plans were based only on a survey of the observable features.

In 1914, the dam was studied by the Pennsylvania Water Supply Commission. This study resulted in the recommendation that the spillway capacity be increased and that, if the dam were raised, the spillway be strengthened.

At some time prior to 1928, the spillway approach walls were raised to their present elevation. Although the reason for this is unknown, it is believed that the walls were raised to increase clearance between spillway crest and low steel of the bridge. In 1943, in order to increase spillway capacity, the spillway crest was lowered by 3.5 feet, or back to its original (prior to 1900) and present elevation of 1352.9. The top of dam was also raised by about 2 feet with earthfill to its present minimum elevation of 1361.5 and paved with asphalt for use as a road.

h. Normal Operating Procedure. The primary purpose of Griffin Dam is water storage. Water is allowed to pass over the spillway or to pass through the outlet works to provide sufficient water at a distribution reservoir about 1.5 miles downstream. Water is also pumped from the reservoir by two submersible pumps in the middle of the reservoir. These pumps are not associated with the dam or any of its features.

1.3 Pertinent Data.

a. Drainage Area. 3.8 square miles.(1)

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - unknown.(2)
Emergency drawdown line at maximum pool elevation (30-inch diameter blowoff and 8-inch diameter siphon) - 120 (approximate).(3)
Spillway capacity at maximum pool elevation - 1,360.

(1) Owner and DER records show 3.2 square miles. GFCC computed 3.8 square miles and used this figure in the study.
(2) Reported by caretaker to be 1.0 foot over spillway within recent period (approximately 10 years).
(3) The siphon would be inaccessible for all but very low flows over the spillway.

c. Elevation. (Feet above msl.)

Top of dam - 1361.5.
Maximum pool - 1361.5.
Normal pool - 1352.9.
Upstream invert outlet works (30-inch diameter pipe) - not available.
Downstream invert outlet works (30-inch diameter pipe) - 1318.5.
Upstream invert water supply line - none.
Streambed near outlet works - 1321.7.
Upstream invert outlet works (8-inch diameter pipe) - 1348.0.
Downstream invert outlet works (8-inch diameter pipe) - 1318.5.

d. Reservoir Length. (Miles.)

Normal pool - 0.60.
Maximum pool - 0.62.

e. Storage. (Acre-feet.)

Normal pool (spillway crest) - 1614.
Maximum pool (top of dam) - 2581.

f. Reservoir Surface. (Acres.)

Normal pool (spillway crest) - 109.7.
Maximum pool (top of dam) - 117.8.

g. Dam.

Type - Combination earthfill and masonry gravity structure.

Length - Exposed portion of masonry gravity structure - 340 feet.

Height - 40 feet.

Top Width - Masonry gravity structure - 4.0 feet.
Earthfill structure - 18.0 to 20.0 feet.

Side Slopes - Upstream earthfill - 1V on 2H (approximate).
Downstream earthfill - varies 1V on 1.3H to 1V on 2.5H.

Zoning - Earthfill upstream and downstream of masonry gravity structure.

Cutoff - Masonry gravity structure may act as cutoff (foundation conditions unknown).

Grout Curtain - None.

h. Diversion and Regulating Tunnel.

Type - Masonry gate structure.
One - 30-inch diameter cast-iron pipe emergency and water supply discharge.
One - 8-inch diameter cast-iron pipe siphon water supply discharge.

Length - 30-inch pipe - 60 feet.
8-inch pipe - siphons water over the spillway.

Access - Through masonry gate structure.

Regulating Facilities - Two manually operated nonrising stem, 30-inch sluice gates on 30-inch line.
One manually operated 8-inch gate valve on siphon.

i. Spillway.

Type - Broad-crested masonry weir (width 6.5 feet).

Length of Weir - 20.0 feet.

Crest Elevation - 1352 .9.

Upstream Channel - Concrete paved slab 20.0 feet wide between vertical approach walls serving as abutments for a bridge over the spillway.

Downstream Channel - Rock-filled pool, 25 feet long by 20 feet wide, with vertical masonry walls. The channel, downstream of the pool, is steep and rocky. The left overbank is about 6 feet above streambed and is flat and wooded. The right overbank rises on about a 1V on 2H slope to about 40 feet above streambed and is wooded. Boulders are strewn over the bottom and side slopes of the channel.

j. Regulating Outlets - None, other than outlet works.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Very little engineering data was available for review for the original structure or any of the subsequent modifications. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account was prepared of information then available. Most of the information used in the study was assumed, as there were no records of design, construction or feature dimensions. Stability computations are on file for the spillway section as it existed in 1914. Hydrology and hydraulic computations for the spillway are included in the 1914 report. After the spillway was modified in 1943, hydrological and hydraulic computations were performed for the Scranton-Spring Brook Water Company by Thomas H. Wiggin, Consulting Engineer, New York City.

b. Design Features.

(1) Dam - Combined Earthfill and Masonry Gravity Structure. Griffin Dam is a combination earthfill and masonry gravity structure. It is irregularly arched in shape, with the abutments being further downstream than the center. Earthfill is located on both the upstream and downstream sides of the masonry gravity structure. An overview photograph is shown on Page b. Available drawings do not show details of the earthfill, but it is probably of homogeneous earthfill construction. Plan and section (1912 data) is shown on Plate 1A; typical sections (1912 data) is shown on Plate 2; and plan and profile (1943 data) is shown on Plate 3. The top of dam is the top of the upstream earthfill section. The top of dam carries an asphalt-paved public road and varies from 18 to 20 feet in width. The elevations along the top of dam vary by about 1 foot, with the low points at Elevation 1361.5 being 100 feet on either side of the spillway centerline. The slope, above the water surface, of the earthfill upstream of the masonry gravity structure is somewhat irregular, but it is approximately 1V on 2H. The slope of the earthfill downstream of the masonry gravity structure is very irregular. The slope is as flat as 1V on 4H in some areas and as steep as 1V on 1.3H in other areas. The slope averages approximately 1V on 2H, except near the left abutment where it flattens and blends with the existing topography. The left abutment is very indistinct, making the end of earthfill not well defined. At the left abutment, downstream of the axis of the dam, a dry masonry retaining wall about 5 feet high exists near the toe of the slope. The wall starts at about the location where the exposed portion of the masonry gravity structure terminates. The wall extends approximately parallel to the axis of the dam for a distance of about 150 feet. At the right abutment,

downstream of the dam, an unpaved road intersects the road over the top of dam at approximately right angles. The downstream earthfill section at the right abutment blends in with the intersection of these two roads. The slope of the upstream earthfill is riprapped, and the slope of the downstream earthfill has a grass cover. Available drawings did not show any internal drainage features for the downstream earthfill.

The masonry gravity structure has a 4-foot top width, vertical downstream face, and unknown batter on the upstream face. The top of the masonry gravity structure is about 2 feet below the top of dam. The top and downstream face of this structure is exposed for 150 feet to the right of the spillway and is exposed for 155 feet to the left of the spillway. The vertical dimension of exposed downstream face varies from 4 to 9 feet.

(2) Spillway. The spillway is a masonry gravity structure, 20 feet wide. Its crest is 8.6 feet below the top of the dam. Downstream of the crest are masonry steps on an overall 1V on 1H slope with masonry retaining walls on each side. A spillway section (1943 data) is shown on Plate 4. The spillway is also shown on Photograph D. The spillway discharges into a pool with dry masonry walls on each side. The bottom of the pool is below stream grade. Except for the area immediately downstream of the spillway toe, the pool is filled with rocks. The approach to the spillway is by a concrete apron of undetermined length, with masonry walls on each side which act as abutments for the spillway bridge. In about the middle and immediately behind the spillway walls, small dry masonry retaining walls are located. Available records do not indicate when or why these walls were constructed. It is believed that they were added to prevent water from splashing over the wall and eroding the earthfill.

(3) Outlet Works. The outlet works consists of a masonry intake structure, 16 feet by 14 feet in plan, on the upstream side of the dam just to the right of the spillway approach channel. The roof is about 10 feet above the top of dam and the bottom of the intake structure is at Elevation 1319.0, about 2 feet below the bottom of the outlet channel. At the bottom of the intake structure are two 30-inch valves with shafts extending up to the working floor at top of dam elevation. One valve permits water to enter the intake structure from the reservoir through a 30-inch diameter cast-iron pipe. The other valve connects to a 30-inch diameter cast-iron pipe which runs out of the intake structure and through the masonry gravity spillway section. This 30-inch pipe discharges at the head of the pool below the spillway. This 30-inch line is used for both an emergency or blowoff line and for water supply. There is also an 8-inch siphon pipe, which starts in the reservoir and runs along the inside face of the right spillway wall, passes down on top

of the stepped cascade, and discharges into the pool below the spillway. The 8-inch siphon is used for water supply.

2.2 Construction.

a. Data Available. No construction data for the original structures was available for review. The survey data performed in 1912 by the Scranton Gas and Water Company is available, as well as the assumed methods of construction made by the Pennsylvania Water Supply Commission for their 1914 report. Recommendations from the 1914 report were not completely acted upon until 1943. Drawings for the modifications performed in 1943 are available, however, they are not detailed. Construction data for the modifications was not available for review.

b. Construction Considerations. Since the available construction data is limited, construction methods cannot be assessed.

2.3 Operation. Few formal records of operation were available for review. The dam has been inspected at irregular intervals by Commonwealth authorities since 1919 and, in recent years, on an annual basis by the Owner. Most of the observations made during this inspection are also indicated on previous inspections. The Owner indicated that some of the problems that were observed in this inspection have existed for many years.

2.4 Other Investigations. No known investigations other than those previously described were reviewed.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer, the caretaker, and a valve crew for information and operating demonstrations during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data is limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data, except for the unobservable dimensions of the spillway masonry gravity section and the masonry gravity structure of the dam. The foundation elevations for these structures are also in question. The dimensions and elevations in question first appeared on drawings dated 1924. There were no drawings available for review, dated prior to 1924, that had these dimensions and elevations. The Owner did not know the source of this information. Since this information was not available for the survey performed by the Scranton-Spring Brook Water Company in 1912 or for the Pennsylvania Water Supply Commission 1914 report, and since the Owner did not know the origin of the information, its validity must be questioned.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The general appearance of this project indicated that some project features have deteriorated with age and are in need of repair, while other project features have been properly maintained and are in good condition.

b. Dam.

(1) The downstream earthfill had sod in excellent condition. There was evidence of a recent brush cut with small stumps remaining over the entire earthfill slope (Photograph A). Stalks remaining from the cutting, up to 1-inch diameter, covered the slope. The slope is very irregular but it closely agrees, as determined by two surveyed sections performed for this inspection, with the survey of 1912. The tree line is approximately at toe of earthfill slope. The slope of the upstream earthfill is somewhat irregular but averages, as determined by two surveyed sections performed for this inspection, to be about 1V on 2H. The riprap on the slope stops 2 feet below top of dam. Riprap is missing from other areas, leaving bare spots typically 6 feet long by 3 feet wide (Photograph F). These bare spots are apparently the result of riprap sliding toward the reservoir as the riprap layers immediately below the bare spots are thicker than in other areas. Some of the fill under the riprap has eroded, leaving stones unsupported by the fill and resting only on adjacent stones. The riprap is shale and some has completely deteriorated. There are a number of erosion gullies, probably caused by runoff from the road, in the upstream earthfill. These are typically 1 to 2 inches deep, but one about 6 inches deep was observed. The earthfill behind the spillway left approach wall was observed to be eroded and the back of the wall was visible for about 6 inches.

(2) There are three wet areas adjacent to the dam (Photographs A and E). Two of these, one on each side of the spillway, are 125 feet downstream of the spillway crest or about 70 feet downstream of the toe. The area to the left of the spillway is offset about 100 feet from the spillway centerline. It is about 600 square feet in area and is covered with leaves and twigs. There is no observable seepage. The area to the right of the spillway is offset 60 feet from the spillway centerline. It is about 900 square feet in area and located in a rocky, mossy area which is about 3 inches higher than the downstream water surface in the channel. There was clear seepage from it that was estimated at 0.1 gallon per hour. Both of these areas were very slick. The boots of inspectors walking over the area penetrated

the surface by about 3 inches. The soil observed in these areas was organic. The third wet area is located on the right abutment, just downstream of the earthfill section. It is located about 70 feet downstream of the spillway crest and about 70 feet to the right of the spillway. This wet area is separated from the other wet area on the right side of the spillway by a small rocky ridge. This wet area is somewhat softer than the other two. The boots of inspectors walking over the area sank up to 6 inches in what appeared to be organic soil. This wet area covers about 500 square feet and is covered with leaves and twigs. From the shape of the abutment slope, above this wet area, it appeared that sloughing could have previously occurred. As there were trees up to about 1 foot in diameter growing in the abutment slope, any sloughing would not have been recent.

(3) The mortar of the masonry gravity structure of the dam has deteriorated, especially over the upper 50 percent of the exposed downstream face. On the average, it was possible to insert a rule 4 inches into these joints. The entire exposed face from slightly below spillway crest to bottom of exposed face was wet from joint seepage. Seepage was insufficient to collect at the bottom of exposed face. In one case, a rule was inserted 1.5 feet. Grass is growing in many of the joints and only soil-like material is visible in some joints.

c. Appurtenant Structures.

(1) Water was flowing over the spillway. Therefore, the downstream face of the spillway could not be inspected in detail. The stepped stone cascade had no stones missing, but many of the stones had their tops slaked off. The steps were also undercut, as the lip of the steps extended, in general, about 2 inches beyond their base. A visit was made to Griffin Dam about a week after the inspection. During this visit, water was not flowing over the spillway. No additional deficiencies were noted during this second visit.

(2) Downstream of the stepped cascade, mortar has deteriorated over the upper half of the masonry spillway walls. The small auxiliary dry masonry wall on the right side of the spillway has tilted backwards (Photograph D). It makes an angle of about 45° with the vertical. This wall has a maximum height of about 2 feet. There are signs of erosion under the wall. Each masonry block in the right and left spillway training walls, that are located directly above the spillway crest, has a fine diagonal crack about 6 inches long. At the junction of the right spillway approach wall and the intake structure, there appears to be an open joint; this area was not accessible for close inspection. At the junction of the left spillway wall with the masonry gravity structure of the dam, there is seepage through the masonry joints below spillway crest. The masonry blocks in this area were wet, but there was insufficient seepage to cause flowing water.

(3) The ladder that extends from the working floor of the intake structure to the bottom of the structure was rusty. A high velocity jet of water from the intake pipe was flowing through the bottom of the structure. Because of these conditions, the intake structure could not be examined in detail. It was noted that there was leakage into the intake structure through the upstream face. The leakage was estimated at 1 gallon per minute. Because of the jet of water, the valves at the bottom of the intake structure were not able to be inspected. The Owner reported that the downstream valve was fully open and the upstream valve was 5 percent open. It took two men 15 minutes to open the upstream valve another 5 percent. The valve appeared to be very stiff and much torsion was noted in the 40-foot long shaft rising to the working floor. The Owner requested that the operation be stopped after a 10 percent opening in order to minimize sedimentation problems in the downstream channel, which leads to a water supply intake. The Owner reported that the downstream valve is left fully open continuously. Its operation was not observed.

(4) The operation of the 8-inch diameter siphon was not observed (Photograph D). Before operation, the siphon would have to be manually primed by allowing water to enter a plug at the high point of the pipe. Both this plug and the stem to operate the valve, which is at the toe of the spillway cascade, would be submerged during high spillway flows.

d. Reservoir Area. The slopes adjacent to the reservoir are covered with trees, mostly hardwoods. There is an unpaved road along the upper end and left side of the reservoir. A paved road extends around the lower half of the right side of the reservoir. The Owner owns and posts lands on both sides of the unpaved road. There are houses along the right side of the reservoir at a minimum of about 200 feet from the shore. The watershed adjacent to the reservoir is hilly, with no steep slopes visible.

e. Downstream Channel. The downstream channel is rocky with the left overbank, about 6 feet over stream grade, being flat and wooded (Photograph C). The right overbank is approximately a 1V on 2H slope rising for 30 to 40 feet over stream grade. There are very small trees scattered over the outlet channel. The remnants of an old masonry dam, about 150 feet downstream of Griffin Dam, blocks about 60 percent of the outlet channel. The remnants of the old dam rise about 6 feet above stream grade.

3.2 Evaluation.

a. Dam.

(1) Trees and stumps on the slope and at the toe of the downstream earthfill are undesirable. The riprap that is

missing from the slope of the upstream earthfill and the poor quality of remaining riprap is also undesirable. Because of this condition, the slope of the upstream earthfill is not being adequately protected from normal pool fluctuations and wave action. Erosion of the slope will probably continue unless the condition is corrected. The erosion observed behind the left spillway approach wall could significantly decrease the seepage path along the embankment-wall junction during a high pool condition.

(2) The wet area near the right abutment was noted during the Pennsylvania Water Supply Commission inspections of 1928 and 1933. However, according to available records, this wet area was not noted before 1928, during the 1930 inspection, or after 1933. According to available records, the other two wet areas were never noted. The source of water at the three wet areas could not be determined from the inspection. The water could be coming from the natural ground water or from the reservoir. Should the source of water be from the reservoir, the wet areas could cause problems if the areas change significantly. Although it appears that no damage has resulted from the wet areas, the source of the water is unknown. The wet areas are, therefore, of general concern until more information about them is known.

(3) The deteriorated masonry joints in the upper half of the exposed portion of the masonry gravity structure could allow increased seepage during high pool levels and could prevent the structure from acting as a monolith. Some drawings indicate that some parts of the structure were placed without mortar. Such construction is undesirable.

b. Appurtenant Structures.

(1) The downstream face of the spillway is evidencing the effects of erosion. Lack of timely repairs could leak to missing and ineffective blocks in the spillway cascade.

(2) The deteriorated mortar in the upper levels of the spillway walls could allow seepage through the open joings and could prevent the structure from acting as a monolith. The erosion under the tilted dry masonry wall at the right side of the spillway could be caused by surface runoff or by water from the spillway splashing up and running under the wall. The fine cracks in the masonry blocks in the walls by the spillway crest could indicate slight movement of the spillway or they could be caused by the natural freezing and thawing of the blocks every winter. Dynamic loads from vehicles crossing the spillway bridge could also cause these cracks. The open joint between the right spillway approach wall and the intake structure could create a shorter seepage path through the dam. Some drawings indicate that some parts of the spillway walls were placed without mortar. Such construction is undesirable.

(3) The leakage that was observed in the intake structure is believed to be of minor significance, because the inside of the structure can be operated wet and because leakage was from the upstream face. Access to the valves was exceedingly difficult and was probably the cause for the lack of greasing and other maintenance evidenced by the very stiff valve stem.

(4) Because the devices required to operate the siphon would be inaccessible during higher spillway flows, its use for emergency drawdown would be limited.

c. Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam.

d. Downstream Channel. The old breached dam in the outlet channel would raise tailwater during moderate spillway flows. For very high spillway flows, the old dam would probably wash away. Additional discussion on downstream conditions is presented in Paragraph 5.1.e.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir level is maintained at spillway crest Elevation 1352.9 with excess reservoir inflow cascading over the stepped masonry spillway. A 30-inch diameter cast-iron pipe draws water from the reservoir and discharges at Elevation 1318.5 into the downstream channel. The downstream gate valve, inside the intake structure, on the 30-inch line is normally open. The upstream gate valve is usually 5 percent open. When this valve is open more than 10 percent sediment and oxygen deficient water enters the downstream channel. The 30-inch line is normally used as a water supply line but it is also used as an emergency or blowoff line. Water can be drawn from the reservoir by an 8-inch diameter siphon and discharged into the downstream channel. The siphon, however, is seldom used. Water discharged from the reservoir is picked up at an intake about 1.5 miles downstream. Water is also drawn from the reservoir for water supply by two submersible pumps located in the middle of the reservoir.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who checks the spillway and adjusts the water line valve, if necessary, to provide sufficient water to the downstream channel. When the reservoir is below the spillway crest, the caretaker reports the reservoir elevation to the Owner's Engineering Department. This information is used by the Engineering Department for regulating flows in the distribution system. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and for reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are kept on file and are used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons. The slope of the downstream earthfill section is mowed at regular intervals.

4.3 Maintenance of Operating Facilities. It appears that there is no regular maintenance program.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a chain of command diagram for Griffin Dam and a generalized emergency notification list that is applicable for all the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel

can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Griffin Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation. Except for not operating the blowoff line to a fully open position on a regular basis, the operational procedure appears to be satisfactory. Infrequent operation of this blowoff to its fully open position could affect its functioning satisfactorily during emergency conditions. The procedures used by the Owner for inspecting the dam are adequate, but repairs have not been made. It appears that maintenance of the operating facilities is not on a regular basis. In general, the warning system is adequate, but it is not in sufficient detail for Griffin Dam when its overall condition and importance is considered.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic and hydraulic analysis for the original Griffin Dam design was available for review. The spillway capacity has been estimated several times.

(2) In the recommended guidelines for safety inspection of dams, the Department of the Army, Office of the Chief of Engineers (OCE) established criteria for rating the capacity of spillways. The recommended spillway design flood for the size (intermediate) and hazard potential (high) classification of Griffin Dam is the Probable Maximum Flood (PMF). If the dam and spillway are not capable of passing the PMF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

(3) In 1944, Thomas H. Wiggin, Consulting Engineer, New York City, prepared a hydrology and hydraulic report analyzing the changes made to the dam in 1943. In this report, the spillway capacity was estimated as 1,260 cfs at maximum pool. Calculations were performed to check the spillway capacity estimate of 1,260 cfs. The spillway capacity was calculated to be 1,360 cfs. The spillway capacity of 1,360 cfs was used for this study.

(4) The Griffin watershed is partially owned by the Pennsylvania Gas and Water Company. Some of the watershed is developed. Hydrologic analysis for this study was based on existing conditions and the effects of future development of the watershed were not considered.

b. Experience Data. The PMF used for this study was derived by transposition of peak flows from hydrologically similar potential reservoir site at Fall Brook. The PMF peak flow is 9,060 cfs.

c. Visual Observations. There is 8.55 feet between the low steel of the spillway bridge and spillway crest. There is 8.60 feet between spillway crest and low point of top of dam. There is a large potential for debris buildup on the steel bridge beams during floods.

d. Overtopping Potential. For an occurrence of the PMF, the peak inflow of 9,060 cfs is greater than the spillway capacity of Griffin Dam. A check of the storage effect of Griffin Reservoir shows that the storage available is insufficient to contain an inflow with a peak flow of 9,060 cfs without overtopping the dam (Appendix C).

e. Downstream Conditions. Griffin Dam is located 0.9 mile upstream of Interstate Route No. 81, as indicated on Plate 1. In the reach between the interstate and the dam, the only habitations are over 40 feet above streambed. After the creek passes under the interstate, it flows between the Pennsylvania Turnpike and the interstate for 0.8 mile. There are structures along this reach less than 20 feet above stream grade. The stream then flows for 2.0 miles parallel to Interstate Route No. 81 and U.S. Route Nos. 6 and 11. There are at least three houses along this reach which are close to the stream and sufficiently low to be flooded by the failure of Griffin Dam. Within this reach, the stream flows in and out of a small intake reservoir which would have insignificant mitigating effect on floodflows. Also within this reach, the stream passes under the interstate at one location and the U.S. Routes at two locations. Below this reach, the stream flows for 2.1 miles through a section of the City of Scranton to the Lackawanna River. The area is very heavily populated. There was insufficient information available to assess the effects of the highway embankments and water passages under them. Unless it can be shown that the effects significantly attenuate this failure hydrograph from Griffin Dam, a high hazard classification for Griffin Dam is warranted.

f. Spillway Adequacy.

(1) The spillway capacity will not pass the PMF without overtopping the dam. One-half of the PMF inflow is 4,530 cfs and is greater than the spillway capacity. A check of the storage effect of Griffin Reservoir shows that the storage available is insufficient to contain an inflow with a peak flow of 4,530 cfs without overtopping the dam (Appendix C).

(2) The maximum tailwater is estimated to be Elevation 1327.9 at the spillway capacity of 1,360 cfs. At maximum

pool elevation, there is a difference of about 34 feet between headwater and tailwater. If Griffin Dam should fail due to overtopping, the hazard to loss of life downstream from the dam will be significantly increased from that which would exist just prior to overtopping.

(3) Based on established OCE criteria as outlined in Paragraph 5.1.a.(2), the spillway capacity of Griffin Dam is rated as seriously inadequate. Considering the effects of the surcharge storage of 967 acre-feet, the spillway discharge capacity of 1,360 cfs can accommodate a flood with a peak inflow of 2,360 cfs for a storm of the same duration as the PMF. This is 26 percent of the PMF peak inflow.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of the dam and spillway resulted in some observations that are relevant to structural stability. These observations are listed herein for the various features.

(2) Dam. Wet areas were observed near the downstream earthfill. The detailed description and evaluation of the condition are in Paragraphs 3.1.b.(3) and 3.2.a.(3), respectively. Deterioration in the mortar along the exposed downstream face of the masonry gravity structure was noted during the inspection, as was grass growing at open joints. The detailed description and evaluation of the condition are in Paragraphs 3.1.c.(3) and 3.2.b.(3), respectively.

(3) Spillway. Due to flow over the spillway during the inspection, the spillway could not be inspected in detail. However, the discrepancies observed and their evaluation are in Paragraphs 3.1.c.(1), 3.1.c.(2), 3.2.b.(1), and 3.2.b.(2). Some seepage through the joints has been observed on the spillway walls, also two fine cracks, open joints and mortar deterioration were observed. A detailed description and evaluation are in Paragraphs 3.1.c.(2) and 3.2.b.(2) respectively. No significant movement, displacement or cracks were noticed during the inspection of the abutments.

b. Design and Construction Data. No records of design data or stability computations for the original structure or for subsequent modifications were available for review. However, a stability study for the spillway was performed in 1914 by the Pennsylvania Water Supply Commission, and the results of the analysis are on file.

The 1914 analysis was reviewed to assess the stability of the spillway. Since the spillway crest was lowered and the upstream earthfill section was raised after these computations were performed, the analysis is not valid for the existing condition. For this study, an additional analysis was performed on the spillway section. The loading assumptions were as follows: pressure from the earthfill against the upstream face, water at maximum pool level, full hydrostatic head on the upstream face and uplift varying uniformly from full tailwater at the toe to full

tailwater at the heel plus 2/3 of the difference between headwater and tailwater also applied at the heel. Only the bottom of the maximum section was analyzed. The analysis showed the resultant outside the middle third. It is located inside the base 1.9 feet from the downstream toe. OCE guidelines on overturning recommended that the resultant be within the middle third. Although the resultant is outside the middle third, it is within the base, and assuming that the spillway is on a rock foundation and considering that the toe pressure is within acceptable limits, the resultant being outside the middle third is not considered to be a significant deviation from the recommended guidelines. The dimensions used in the stability analysis were obtained from 1943 drawings. These drawings were traced from drawings originally prepared in 1924. The validity of these dimensions is questionable as was noted in Paragraph 2.5.c. Furthermore, the nature of the actual foundation conditions is unknown. Therefore, the structural stability of the spillway under the maximum loading condition cannot be determined.

c. Operating Records. There is no evidence that any stability problem has occurred for the dam or spillway during the operational history of the dam.

d. Post Construction Changes. Department of Environmental Resources and Pennsylvania Gas and Water Company files show that the spillway was raised 1.5 feet and 2.0 feet in 1901 and 1910, respectively. In 1943 the spillway was lowered by 3.5 feet back to its original and present elevation of 1352.9 and the top of dam was raised by up to 2.0 feet.

e. Seismic Stability. Griffin Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there is the potential of earthquake forces moving or cracking the masonry gravity structure of the dam and the masonry gravity spillway section, the theoretical seismic stability of this dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on visual inspection, available records, calculations, and past operational performance, Griffin Dam is judged to be in fair condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Dam:	
Downstream earthfill section	Stumps in slope and tree line at toe.
Upstream earthfill section	Erosion gullies on slope, erosion under riprap and riprap weathered.
Junction upstream earthfill section with left spillway wall	Erosion behind wall.
Masonry gravity structure	Seepage and deteriorated mortar on exposed downstream face.
Downstream right abutment	Wet area.
Downstream of earthfill toe	Wet areas.
Spillway:	
Downstream face and crest	Erosion of masonry blocks.
Walls	Seepage and deteriorated mortar.
Crest	Crack at each side.
Right approach wall	Open joint.
Right auxiliary wall	Tilted with erosion beneath.

Feature and Location	Observed Deficiencies
Outlet Works:	Lack of regular maintenance and operation of blowoff to full open position.
Downstream Channel:	Remains of old dam partially blocking channel.

(2) The overtopping potential analysis shows that the dam will be overtopped by the PMF and one-half PMF. Based on OCE criteria, as outlined in Paragraph 5.1.a.(2), the spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 26 percent of the PMF peak inflow.

(3) Review of the 1914 stability analysis computations for the masonry gravity spillway and computations made for the purpose of this study indicate that the resultant is within the base, 1.9 feet from the downstream toe. The computed factor of safety for sliding and toe pressure were within acceptable limits for the assumed foundation conditions. The stability analysis was based on uncertain structural dimensions and on assumed foundation condition. Therefore, the structural stability of the spillway cannot be determined.

b. Adequacy of Information. The information available is such that a total assessment of the dam cannot be inferred from the information available. Not only are structural dimensions uncertain, but the nature of the foundation under the structure is unknown.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as soon as practical or in a timely manner as noted.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2 further investigations will be required.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for safety of Griffin Dam, the following measures are recommended to be undertaken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Griffin Dam.

(2) Perform a detailed study for remedial work to meet hydraulic deficiencies of the spillway. Make field investigations to obtain dimensions and foundation conditions of structures as required to determine structural stability. Perform a detailed study for any remedial work required to meet any structural deficiencies of structures.

(3) Perform a study which addresses the hydraulic effects of the downstream dam, to determine if it raises the tailwater to a damaging level to adjacent properties.

b. In order to correct operational, maintenance and repair deficiencies, and to more accurately determine the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Operate the valves on the gated outlets to their fully open position periodically to ensure that they will be functional during emergency conditions. The usual practice is to open the blowoff discharge line in late winter during periods of high discharge to clean sediment from the bottom of the reservoir. Lubricate the operating mechanisms and repair access facilities.

(2) Remove stumps from the slope of the downstream earthfill section and remove trees that are close to toe of earthfill.

(3) Place a good quality riprap on the slope of the upstream earthfill section as required to ensure full slope protection to top of dam.

(4) Monitor the downstream face of the spillway and make repairs as necessary.

(5) Repair or replace the deteriorated mortar in the joints in the masonry spillway wall and in the joints in the masonry gravity structure.

(6) Repair dry masonry wall at right of spillway.

(7) Install five or more observation wells, or other instrumentation, downstream of the axis of the dam. One well, or other instrumentation, should be located in the vicinity of each wet area. The other two should be at appropriate locations to determine general water level in downstream embankment. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structure and assessing piping potential in the future. Continue to observe wet areas and seepage downstream from dam. If conditions worsen, appropriate action would be taken to control apparent seepage with properly designed drains.

c. Before remedial work, that corrects structural and hydraulic deficiencies, is complete, the following measures are recommended to be undertaken by the Owner:

(1) During periods of unusually heavy rains, provide round-the-clock surveillance of Griffin Dam and have available a crew to clear the spillway of any debris which may collect there.

(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

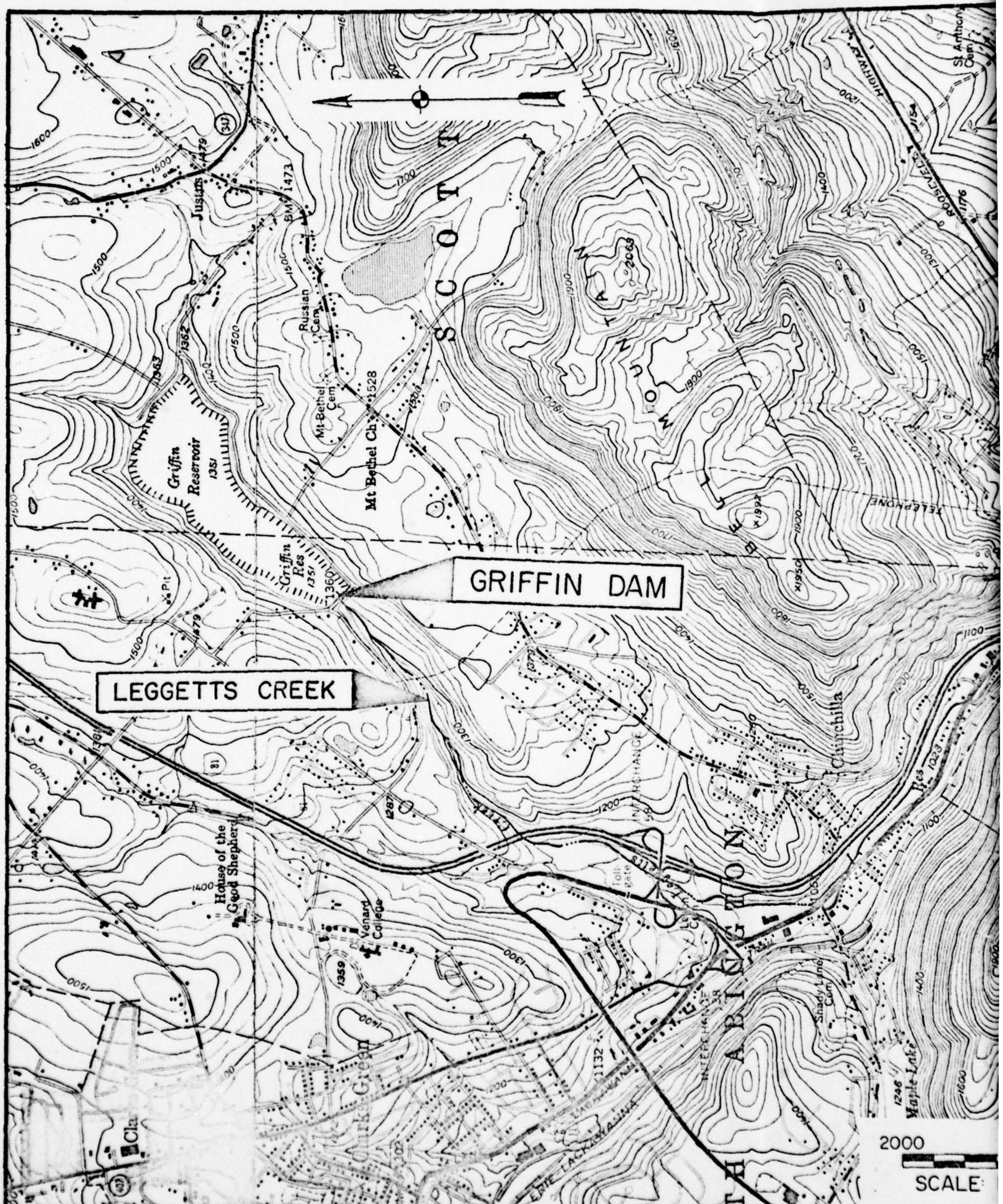
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

PLATES



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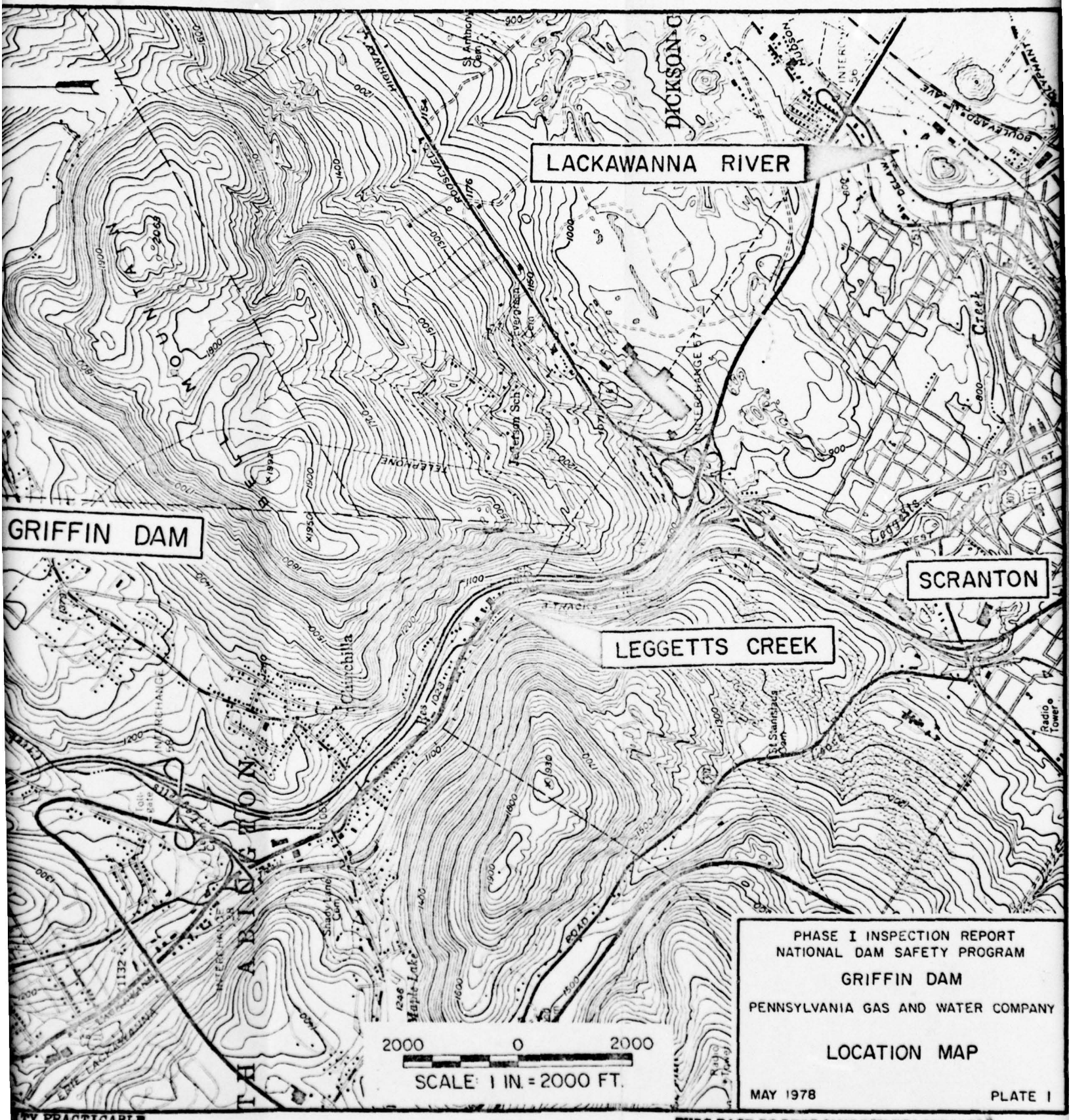


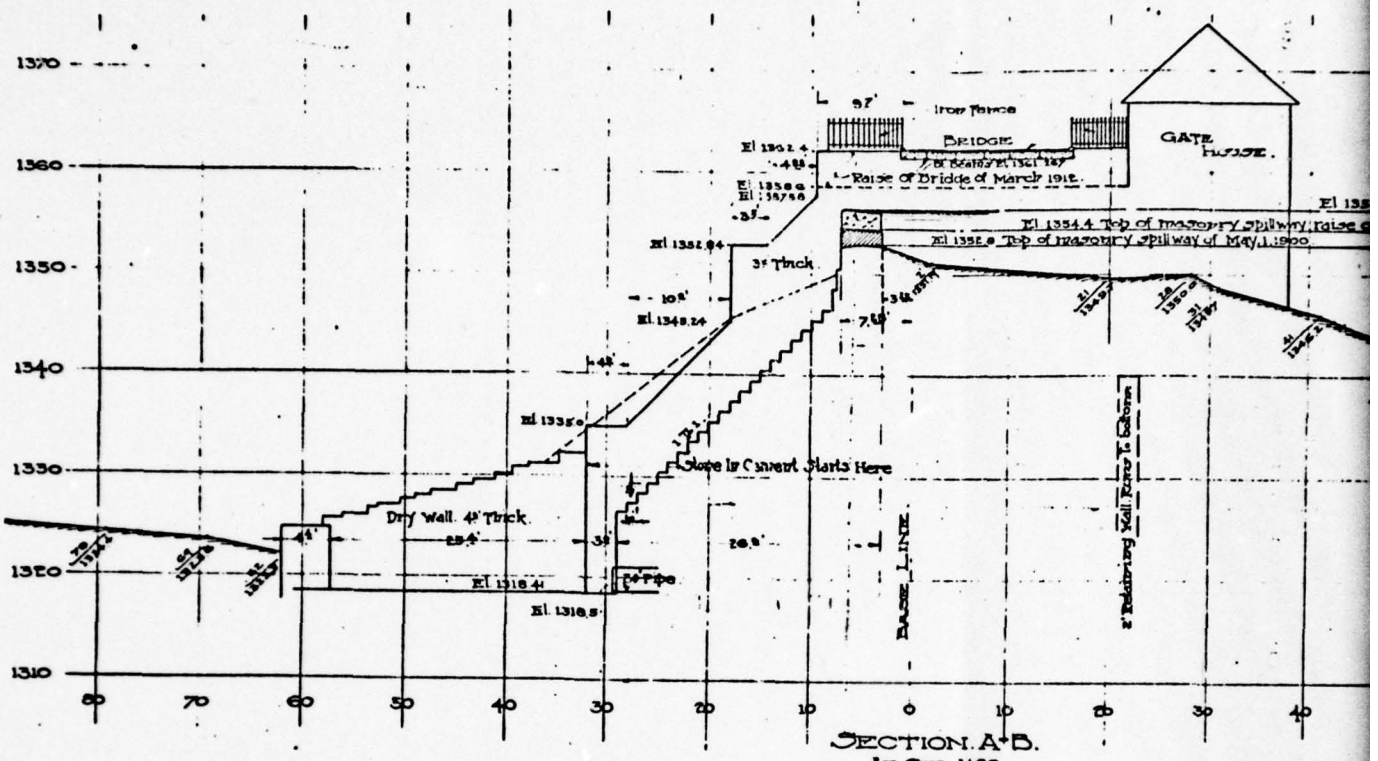
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

GRIFFIN DAM

PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

MAY 1978 PLATE 1



SECTION A-B.
AT STA. 1462.
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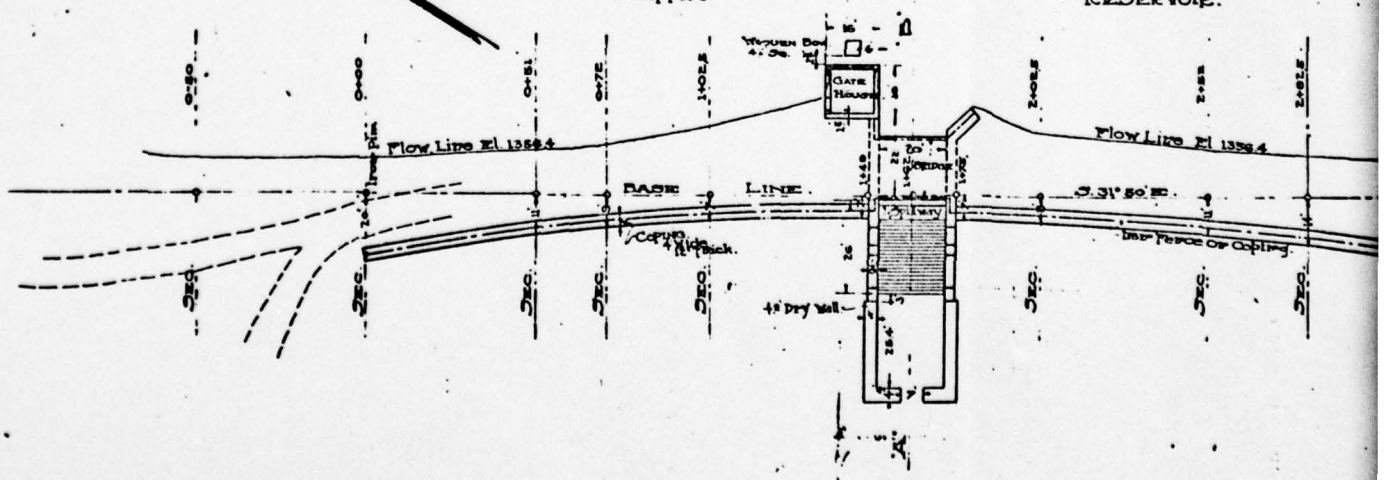
Tracings, May. 18
Scales. As Sh

GRIFFIN RESERVOIR.



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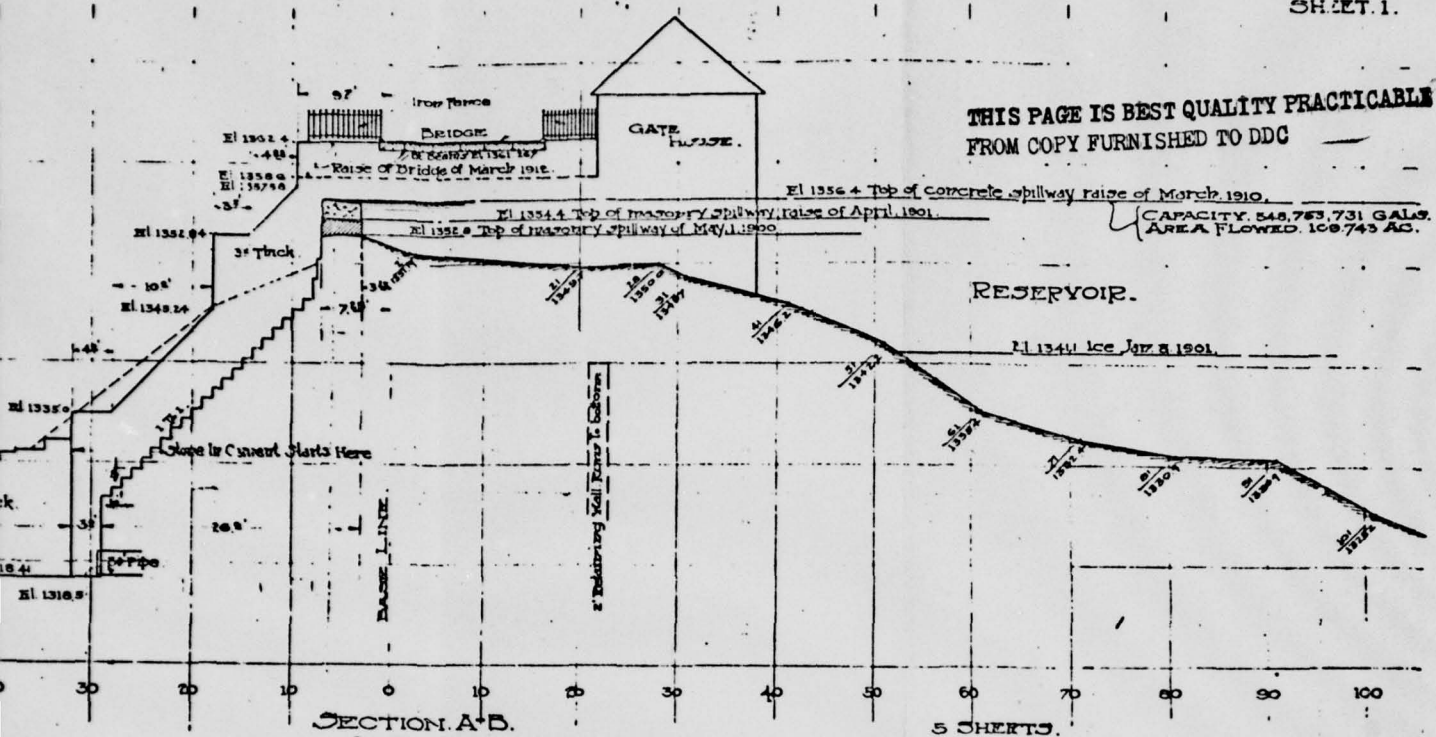

SECTION. A-B.
AT STA. 1462.
SCALES. 1"=10'

5 SHEETS.

PLAN & SECTIONS OF GRIFFIN DAM
THE SCRANTON GAS & WATER CO.

Tracings, May. 18. 1912.
Scales. As Shown.

William M. Marple
Chief Engineer.

Data.
Transit Book No 199 P. 39.
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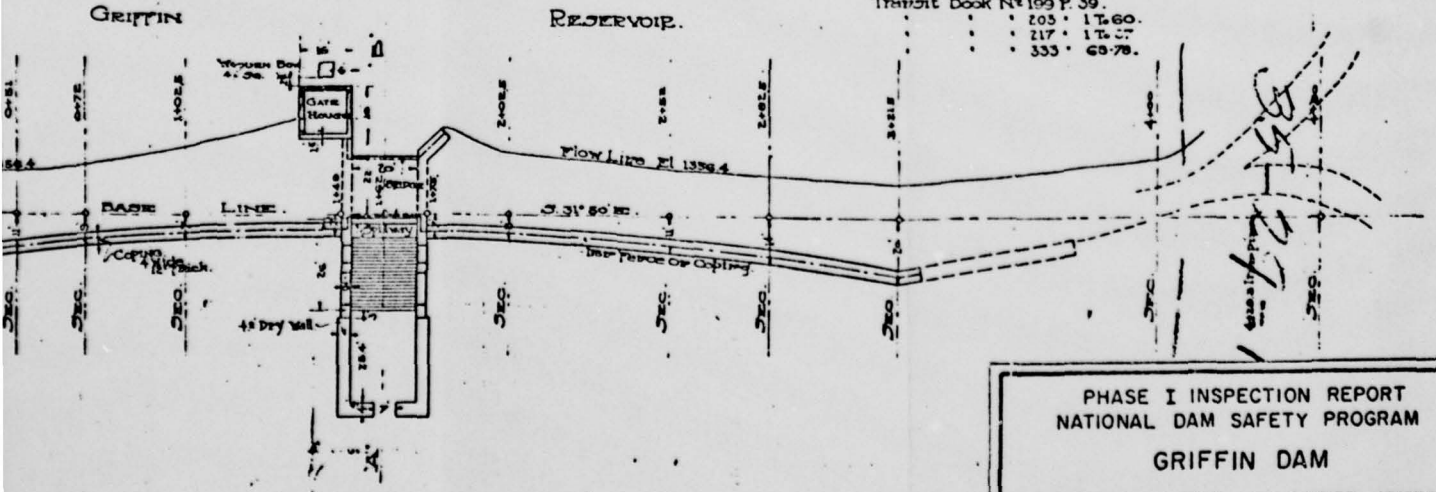
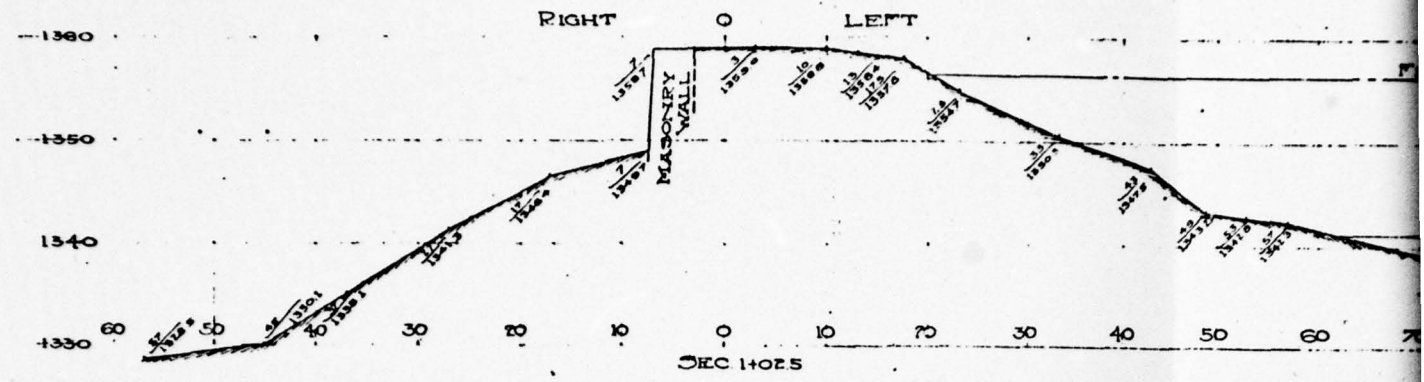
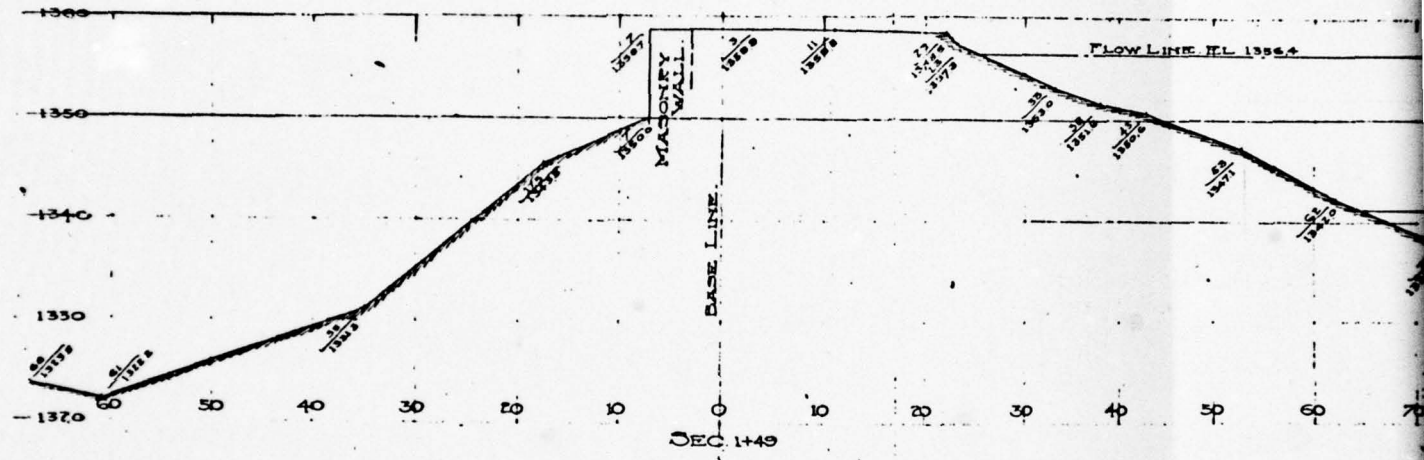
" " 217 - 1 To 37
" " 333 - 65-78.

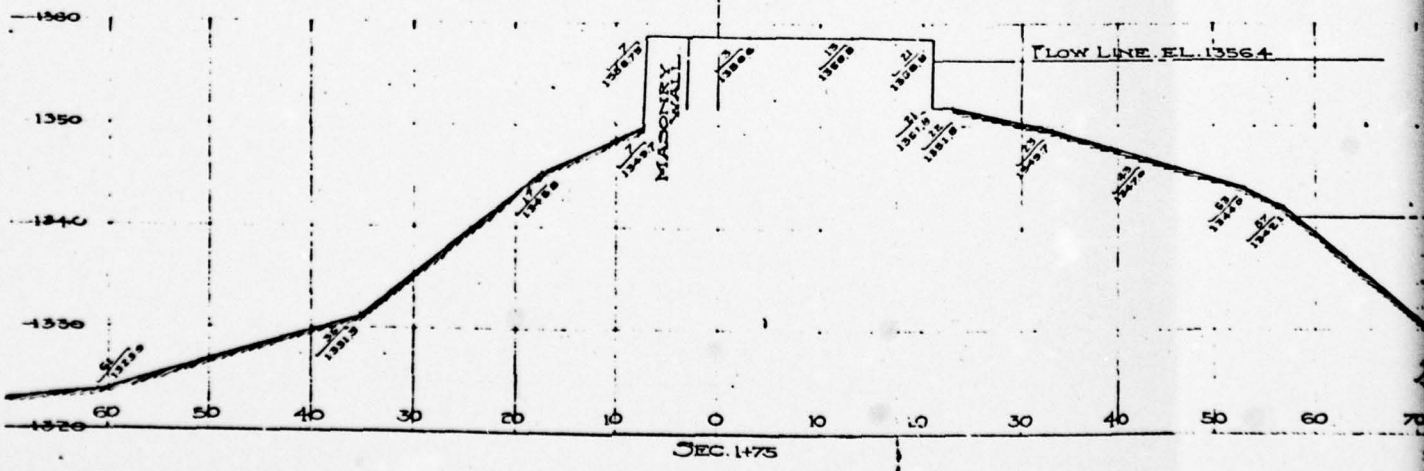


PLAN.
SCALE. 1"=30'

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
GRIFFIN DAM
PENNSYLVANIA GAS AND WATER COMPANY
PLAN AND SECTION
(1912 DATA)
MAY 1978 PLATE 1A

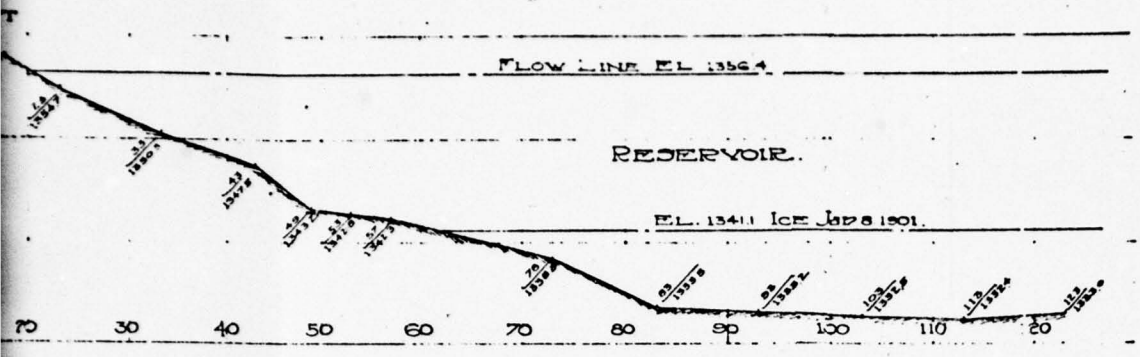


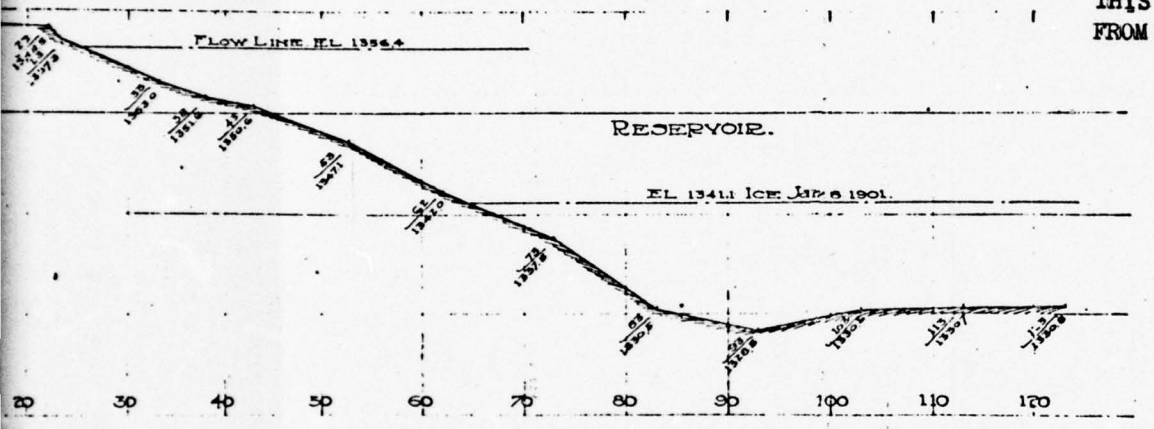


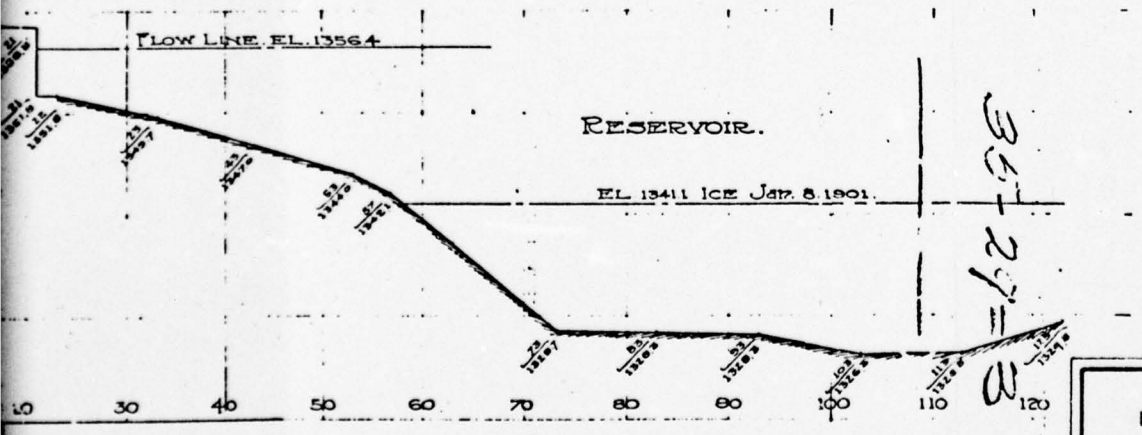


CROSS SECTIONS AT STA'S

SHEET 2.







CROSS SECTIONS AT STA'S. { 1+05 5 / 1+49 / 1+75 } SCALES. 1"=10'

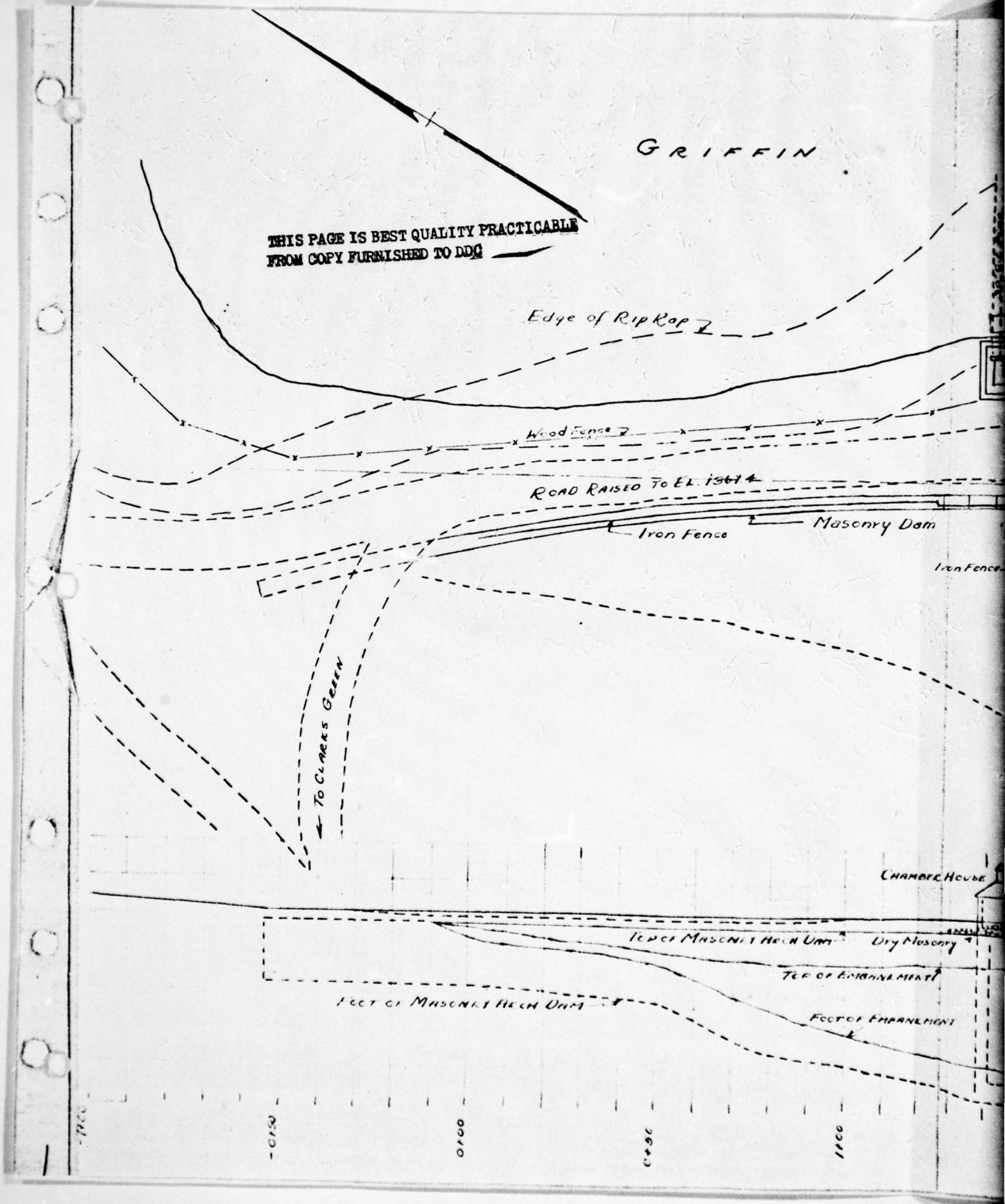
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

GRIFFIN DAM

PENNSYLVANIA GAS AND WATER COMPANY

TYPICAL SECTIONS
(1912 DATA)

MAY 1978 PLATE 2



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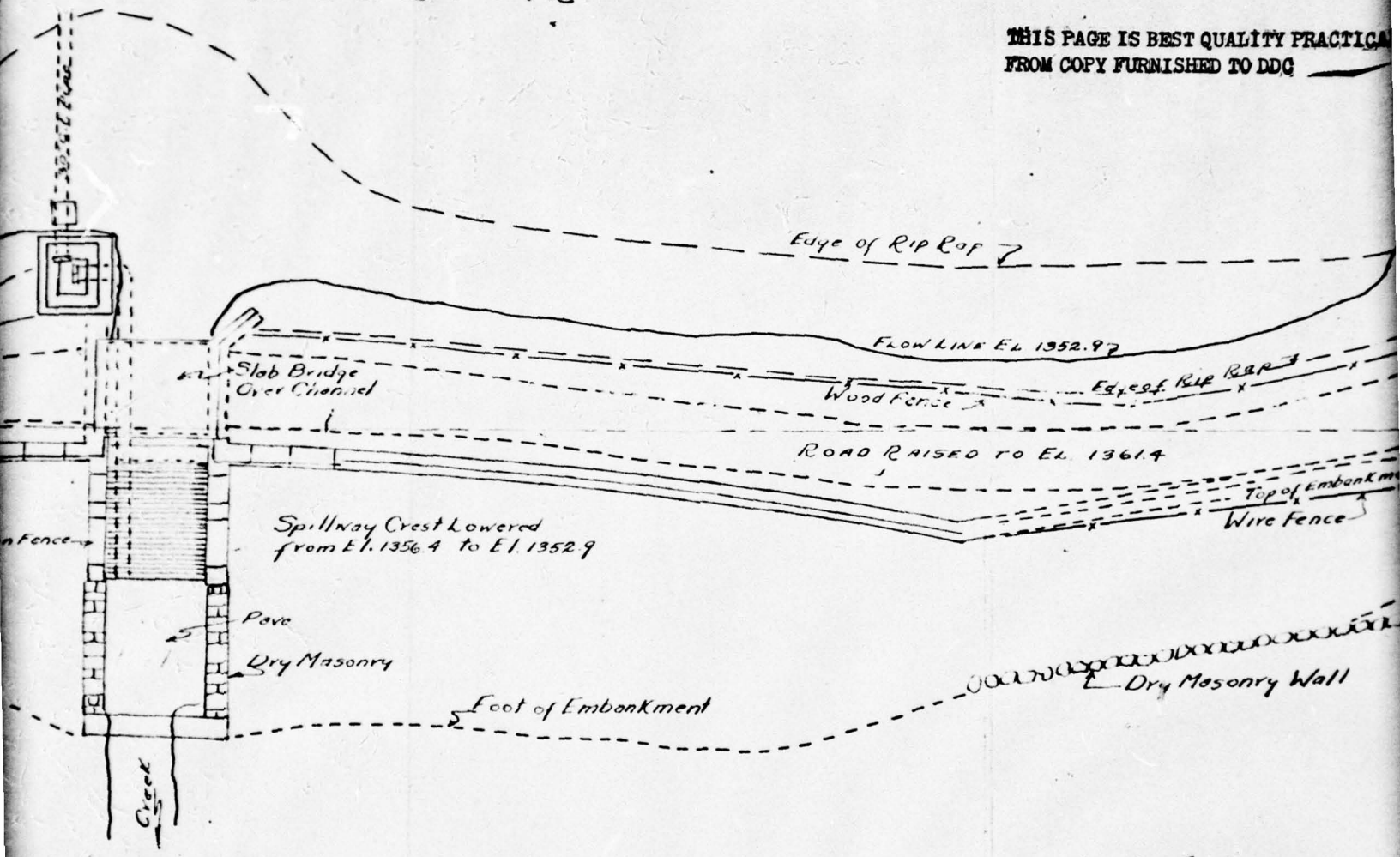

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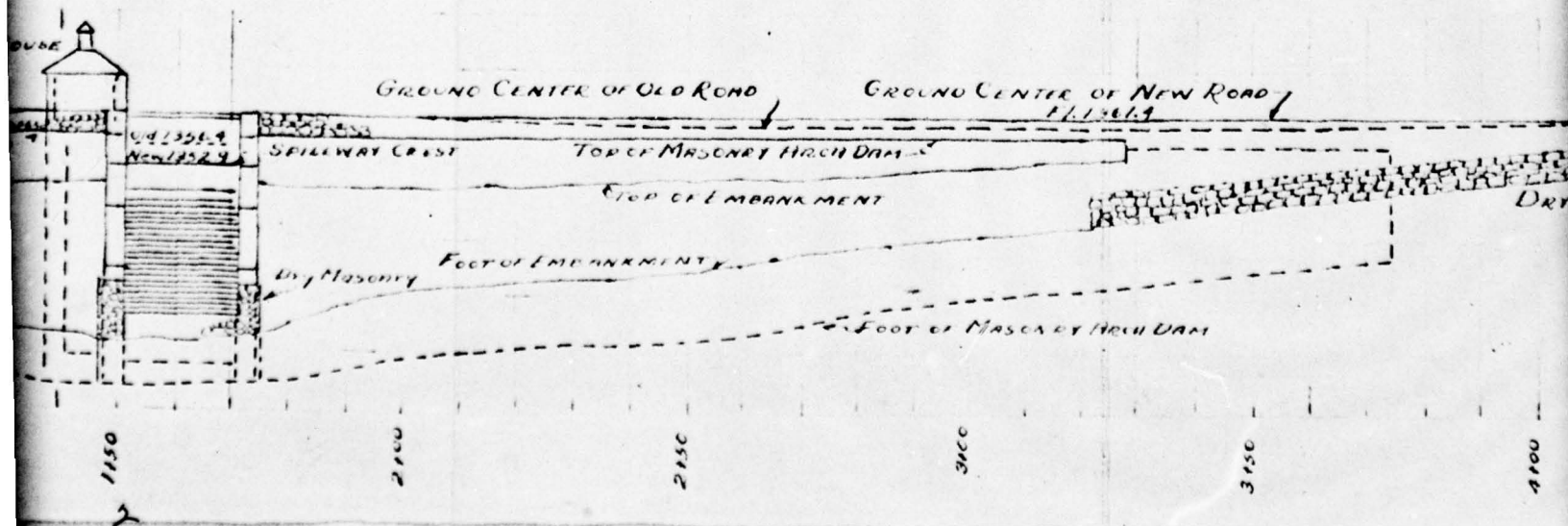

S. G & W. Co.
SUPPLY RESERVOIRS
Sheet 152

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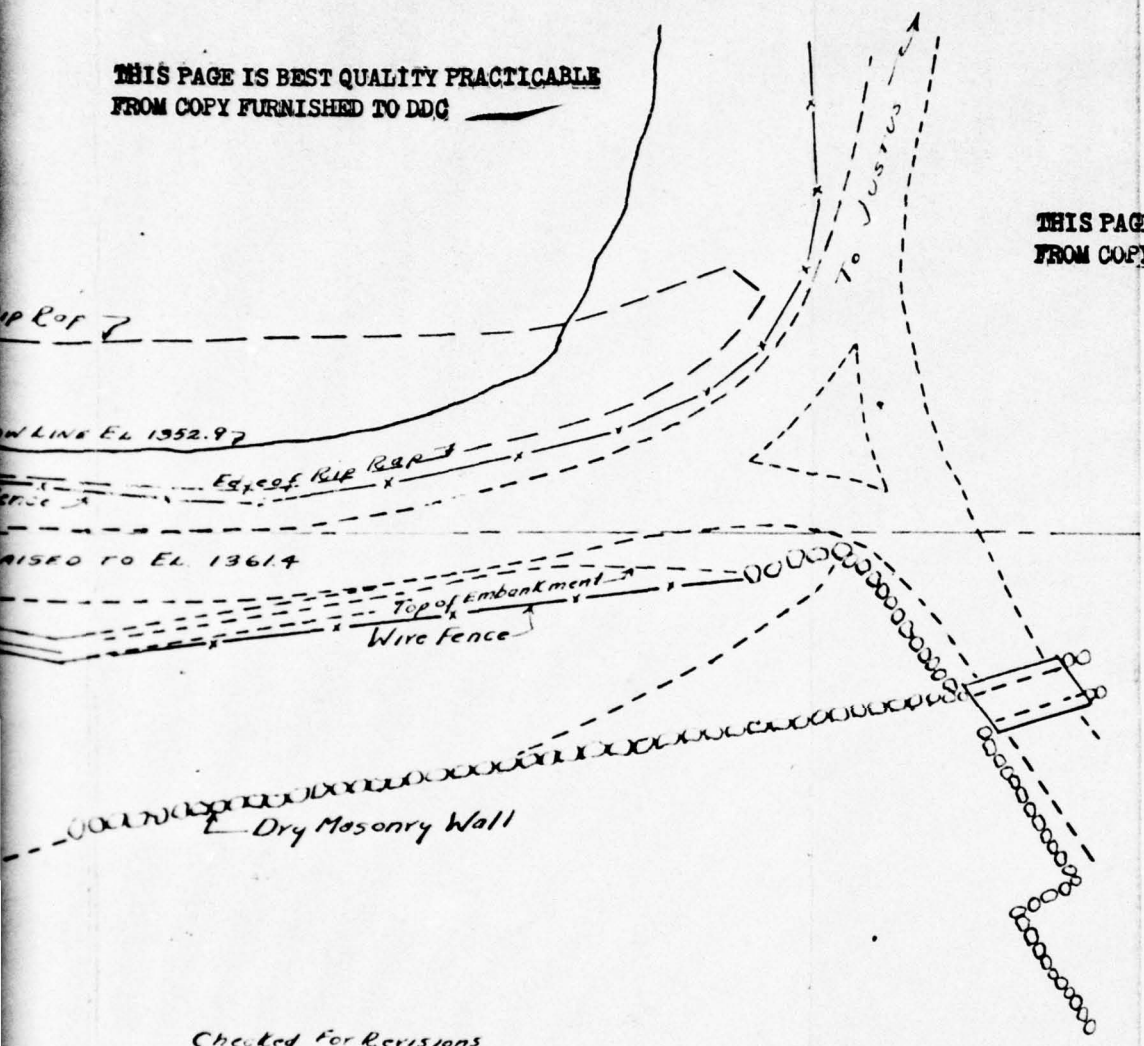

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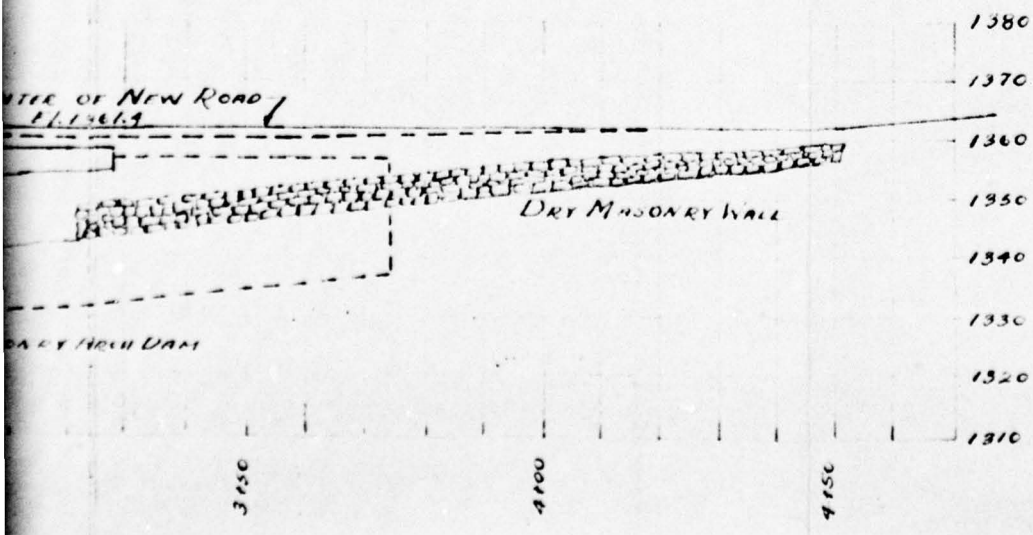


PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

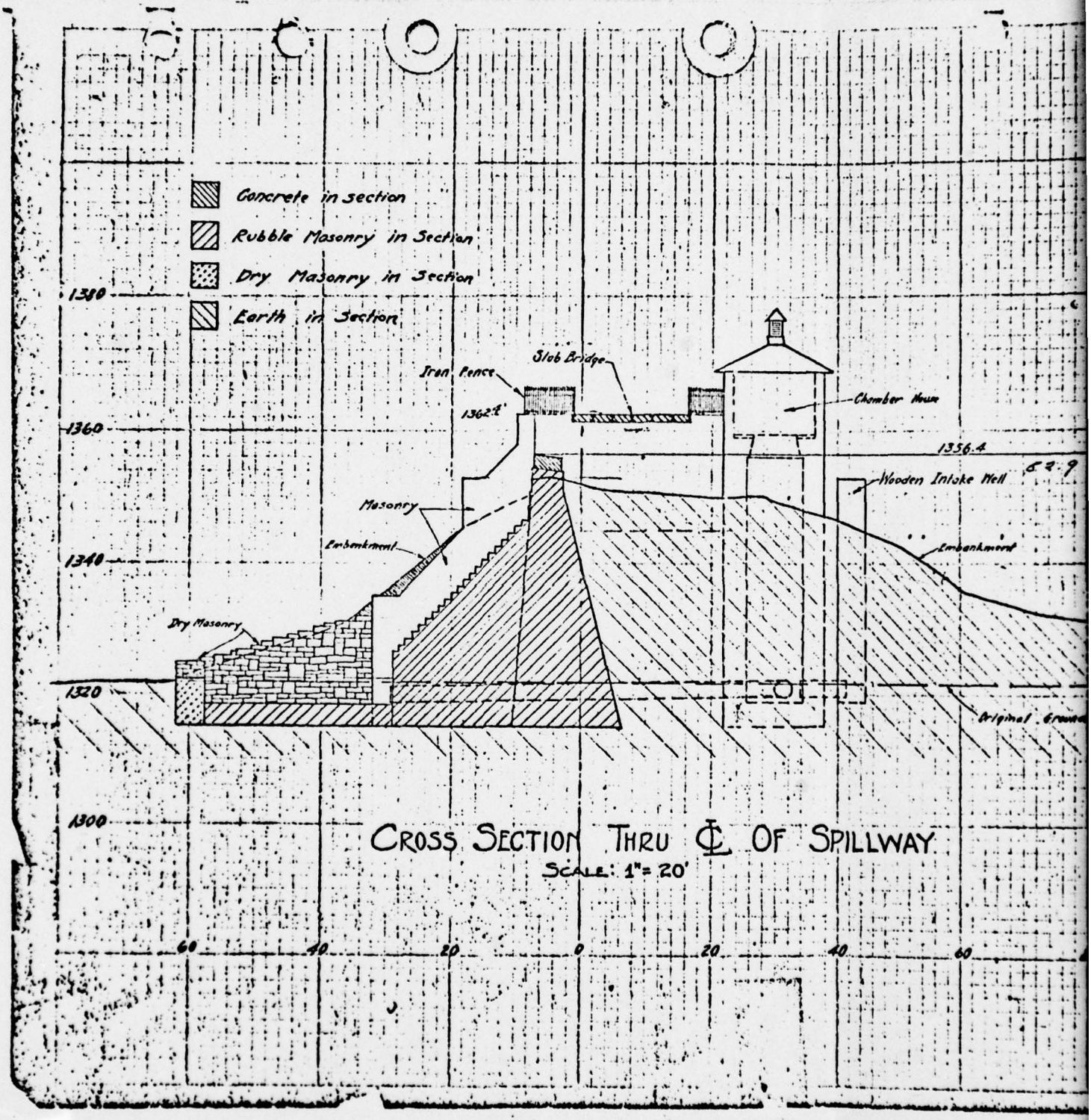
GRIFFIN DAM

PENNSYLVANIA GAS AND WATER COMPANY

PLAN AND PROFILE
(1943 DATA)

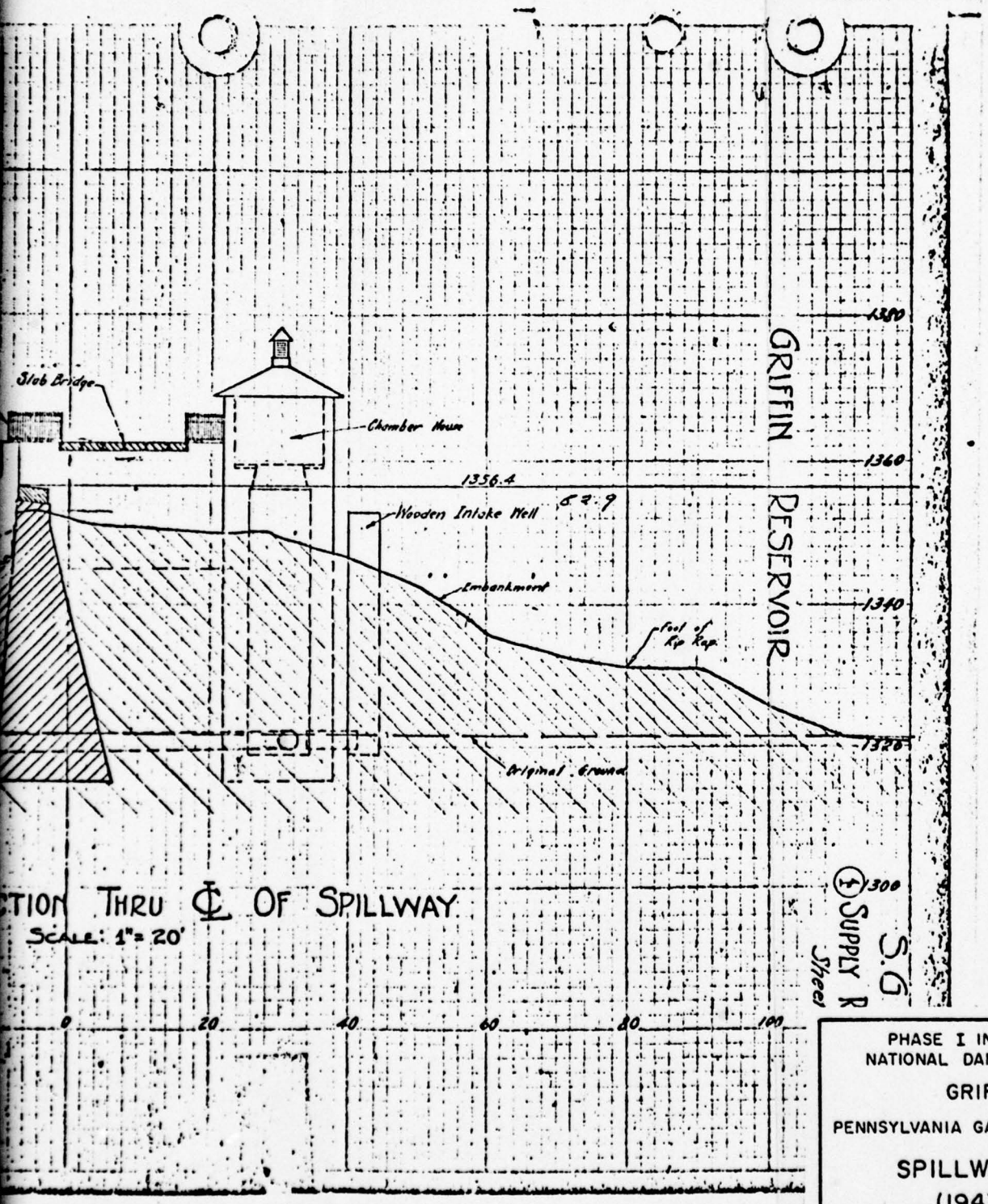
MAY 1978 PLATE 3

3



CROSS SECTION THRU ℄ OF SPILLWAY

SCALE: 1" = 20'



CTION THRU ℄ OF SPILLWAY
SCALE: 1"= 20'

0 20 40 60 80 100

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

GRIFFIN DAM

PENNSYLVANIA GAS AND WATER COMPANY

SPILLWAY SECTION
(1943 DATA)

MAY 1978 PLATE 4

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

MAY 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: GRIFFIN

NDS ID NO.: 188 DER ID NO.: 35-29

ITEM	REMARKS
AS-BUILT DRAWINGS	Construction Drawings of 1943 Modification and Survey of 1912, long after construction, available
REGIONAL VICINITY MAP	Project is shown on the following USGS Quandrangle sheets - Scranton, PA N4122.5-W 7537.5/7.5 1947 Photo Revised 1969 - Dalton, PA N4130-W 7537.5/7.5 1946 Photo Revised 1969
CONSTRUCTION HISTORY	Timber Crib Dam built prior to 1861 Dam built over Timber Crib - 1887 to 1888 Dam rebuilt 1893-1895
TYPICAL SECTIONS OF DAM	Available from survey performed in 1912. No zoning information available.
OUTLETS: Plan Details Constraints Discharge Ratings	Plans available, date of drawings unknown. No other data available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	1944 Report by Thos. Wiggins concerning Hydraulics and Hydrology of 1943 modification. 1914 report by Pennsylvania Water Supply Commission
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1944 Report by Thos. Wiggins concerning Hydraulics and Hydrology of 1943 modification. 1914 stability computations of Pennsylvania Water Supply Commission
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	1912 Survey by Scranton Gas and Water Co.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	NONE in records
MONITORING SYSTEMS	NONE
MODIFICATIONS	1901 - Spillway raised 1.5 feet 1910 - Spillway raised 2.0 feet 1943 - Spillway lowered to original level and dam raised by up to 2 feet
HIGH POOL RECORDS	12" over Spillway maximum reported by caretaker. No formal records available.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	See "Design Reports"
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE RECORDED

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	SEE "AS-BUILT DRAWINGS"
OPERATING EQUIPMENT: Plans Details	NONE AVAILABLE
PREVIOUS INSPECTIONS Dates Deficiencies	1919 - Slight seepage in masonry joints 1925 - Slight seepage 1928 - Slight seepage especially at foot of right hill near downstream toe. Raising of road near spillway noted 1930 - No deficiencies 1933 - Leakage along hillside from right end of structure and in some masonry joints 1941 - Slight seepage through joints in downstream face & through joints behind both spillway abutment walls. Considerable erosion at toe of
(CONTINUED)	spillway. 1943 - Slight seepage in masonry joints. Some erosion at toe of spillway. 1945 - Some seepage through joints and some erosion at toe of spillway.

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1953 - Small leakage through abutments and wasteway walls 1957 - Brush on downstream face 1964 - No deficiencies

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: GRIFFIN DAM NDS ID NO.: 188 DER ID NO.: 35-29

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1352.9 - 1614 acre - ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1361.5 - 2581 acre ft

ELEVATION MAXIMUM DESIGN POOL: 1361.5

ELEVATION TOP DAM: 1361.5

SPILLWAY CREST:
- a. Elevation 1352.9
- b. Type Masonry weir - broad crested
- c. Width 6.5 ft.
- d. Length 20.0 ft.
- e. Location Spillover Center of dam
- f. Number and Type of Gates none

OUTLET WORKS:*
- a. Type 30-inch C.I.P. with valves in wet tower
- b. Location Right upstream spillway approach wall
- c. Entrance Inverts unknown
- d. Exit Inverts 1318.5
- e. Emergency Draindown Facilities 30-inch C.I.P. (above)

HYDROMETEOROLOGICAL GAGES:
- a. Type none
- b. Location none
- c. Records none

MAXIMUM NONDAMAGING DISCHARGE: 1360 cfs

*Also 8-inch syphon upstream invert 1348.0
downstream invert 1318.5

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

PENNSYLVANIA GAS AND WATER COMPANY

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MAY 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: GRIFFIN County: LACKAWANNA State: PENNSYLVANIA

NDS ID No.: 188 DER ID No.: 35-29

Type of Dam: Earthfill with Retaining Wall Hazard Category: High

Date(s) Inspection: April 25 and 26, 1978 Weather: Below Temperature: Below

Soil moist; April 25, Sunny-Dry, 65°F; April 26, Overcast-Breezy, 50°F

Pool Elevation at Time of Inspection: 1353.0 msl/Tailwater at Time of Inspection: 1322.7 msl

Inspection Personnel:

F. Mansour (GFCC)	J. Skoritowski (PG&W)	
P. Van Der Goes (GFCC)	V. Carroll (PG&W)	
D. Ebersole (GFCC)	L. Insaloco (PennDER)	

A. Whitman (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Upstream surface almost totally submerged. No cracks on downstream surface.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	See "Seepage" for downstream slope. Upstream slope - erosion gullies typically 1-2" but 1-6" deep. Erosion (6"±) behind left spillway approach wall.	
CREST ALIGNMENT: Vertical Horizontal	Dam on arc in plan. Vertical alignment surveyed. Low spots 100' left and right of spillway.	
RIPRAP FAILURES	Riprap has slid down in spots leaving areas typically 6' x 3' unprotected. Soil washed out under some areas of riprap.	Riprap extends up to top of old (unraised) embankment only.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	For right abutment - see "seepage" Left abutment no defects. Right spillway auxiliary wall (2' high) Tilted 45° with erosion underneath.	
ANY NOTICEABLE SEEPAGE	3 wet spots (1) 3" boot penetration - no seepage (2) 3" boot penetration - clear seepage at 0.1 GPH SEE LAST SHEET	Wet Spots (1) 125' downstream offset 100' left (2) 125' downstream offset 60' right (3) 70' downstream offset 80' right
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
	Sod - Excellent Evidence of recent brush cut with stalks 1" diameter. Stumps left in slope.	

CONCRETE/MASONRY DAMS

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Seepage starts 90 ft. right of spillway and continues left along masonry gravity structure to end. Seepage is intermittent and approximately at crest level. No flow at toe.	See "Spillway"
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	Visible part of masonry gravity structure just ends at abutments with no visible problems. See "Spillway".	
DRAINS	NONE	
WATER PASSAGES	NONE	
FOUNDATION	NOT VISIBLE	

CONCRETE/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY ~~CONCRETE~~ SURFACES: Surface Cracks Spalling	NONE	
STRUCTURAL CRACKING	NONE	
ALIGNMENT: Vertical Horizontal	Horizontal alignment follows dam arch. Vertical alignment - No visible problems.	
MONOLITH JOINTS	Mortar in very poor condition over upper 50% of masonry gravity structure.	Many joints filled with soil. Some joints have grass growing.
CONSTRUCTION JOINTS	NONE	
STAFF GAGE OR RECORDER	NONE	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30-inch C.I.P. Not observable.	
INTAKE STRUCTURE	Leak in upstream face of structure 1 G.P.M. Unable to see location of leak. Ladder is very rusty.	
OUTLET STRUCTURE	NONE	
OUTLET CHANNEL	Pool below spillway filled with rocks except at outlet of pipe.	
EMERGENCY GATE	Very stiff operation of upstream valve. 1/4 turn of handles on working floor torqued stem with no movement of valve. 15 minutes to open additional 5%	Owner reported downstream valve fully opened. Operation not inspected.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY ~~CONCRETE~~ WEIR	Edge of weir jagged. Spalling at junction of weir cap and concrete approach apron.	
APPROACH CHANNEL	See "Masonry weir". Open joint between intake structure and right approach wall.	
DISCHARGE CHANNEL	Cascade type - Stones slaking Some blocks undercut 1-2"	
BRIDGE AND PIERS	Steel beams with asphalt surface. No defects.	
SPILLWAY WALLS	2 fine cracks, each 6"± long at crest on either side, apparently through stone. SEE LAST SHEET	

GATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	NONE	
APPROACH CHANNEL	NONE	
DISCHARGE CHANNEL	NONE	
BRIDGE AND PIERS	NONE	
GATES AND OPERATION EQUIPMENT	NONE	

P-5

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	IV on 3 H±	
SEDIMENTATION	NONE	Owner reports no sedimentation problems.
WATERSHED DESCRIPTION	Rolling hills with 80% hardwoods.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Remnants of Old Mill Dam blocking 60% of channel.	Dam is 6' high and unmortared. Smooth timber piles lying in stream.
SLOPES	Left 1V on 3 H - 6' high Right 1V on 2 H - 30' to 40' high	
APPROXIMATE NUMBER OF HOMES AND POPULATION	NONE OBSERVED	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE (CONTINUED)	(3) 6" boot penetration - no seepage - area is about 15' x 30' Standing water in all areas after cover removed.	All areas covered by leaves and twigs.
SPILLWAY WALLS (CONTINUED)	Crack on right extends below crest. Seepage, more severe than elsewhere, at Junction left spillway wall and masonry gravity structure.	
SPILLWAY WALLS (CONTINUED)	Mortar deteriorated over upper 50% of spillway walls. Also see "Embankment", Junction with spillway.	

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

NDS ID No. 188

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APPENDIX C

HYDROLOGY AND HYDRAULICS

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Hydraulics and Hydrology FILE NO.
SHEET NO. 1 OF 3 SHEETS
FOR Griffin Dam
COMPUTED BY AHW DATE 5/19/78 CHECKED BY FFM DATE 5-22-78

Griffin Dam

NAB Instructions:
Transpose Peak Flows
using Lake Aylesworth and Fall Brook PMF

	Griffin	Lake Aylesworth	Fall Brook
Drainage Area (mi^2)	3.8 *	6.22	4.14
Q peak PMF		13,700	9,700

* DER & Owner state 3.2 mi^2. GFCC planimetered and used 3.8 mi^2

Use $\frac{Q_1}{Q_2} = \left(\frac{DA_1}{DA_2}\right)^{0.8}$

$Q_1 = Q_2 \left(\frac{DA_1}{DA_2}\right)^{0.8}$

From Lake Aylesworth PMF

$Q = 13,700 \left(\frac{3.8}{6.22}\right)^{0.8} = 9237 \text{ cfs} \approx \underline{9240 \text{ cfs}}$

From Fall Brook

$Q = 9,700 \left(\frac{3.8}{4.14}\right)^{0.8} = 9057 \text{ cfs} \approx \underline{9060 \text{ cfs}}$

NAB curve Susquehanna Region 2 $Q = \underline{9424 \text{ cfs}}$

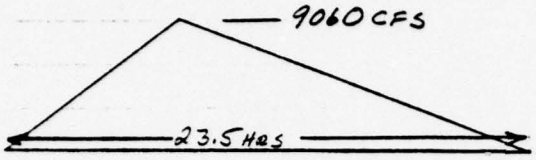
Since Fall Brook Reservoir drainage area is close to Griffin Lake drainage area, use 9060 cfs which is transposed from Fall Brook peak discharge.

PMF = 9060 cfs

Time of Hydrograph (from NAB curve for Susquehanna Basin)
23.5 hrs

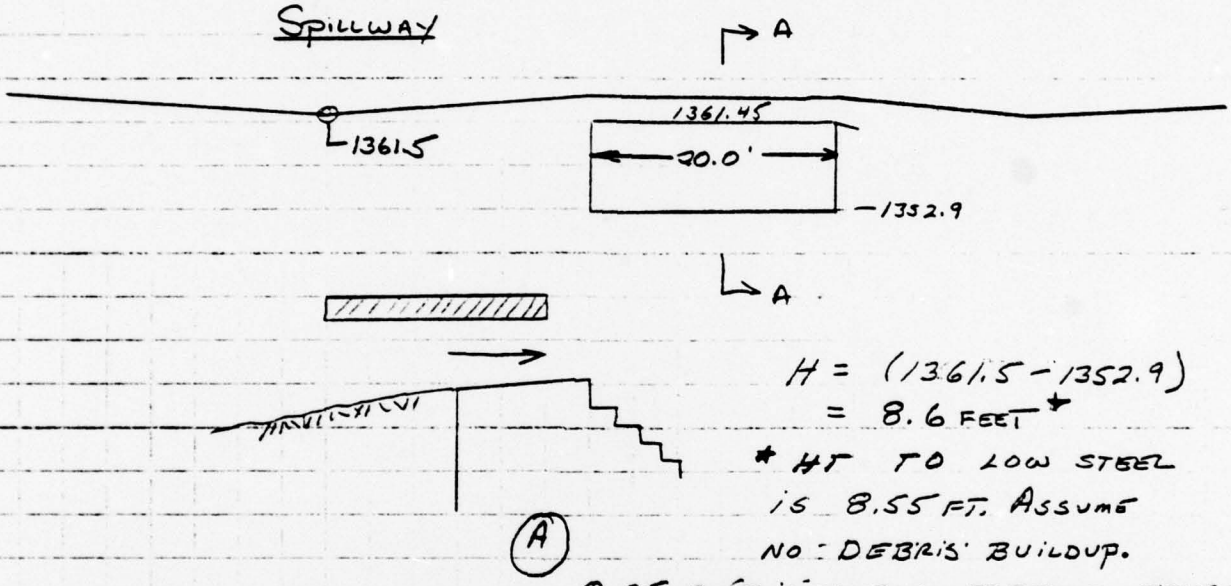
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT HYDRAULICS AND HYDROLOGY FILE NO.
SHEET NO. 2 OF 3 SHEETS
FOR GRIFFIN DAM
COMPUTED BY AHW DATE 5/19/78 CHECKED BY EFM DATE 5-22-78



PMF HYDROGRAPH

SPILLWAY



$H = (1361.5 - 1352.9)$
$= 8.6$ FEET *

* HT TO LOW STEEL IS 8.55 FT. ASSUME NO DEBRIS BUILDUP.

0.05 FOOT IS TOO SMALL TO DEVELOP ORIFICE FLOW

FROM PREVIOUS REPORT BY THOS. WIGGINS, CONSULTING ENGINEER, NYC (1944)

$H = 8.4'$ $Q = 1260$ CFS

$Q = CLH^{3/2}$ $C = \frac{Q}{LH^{3/2}}$

$C_{\text{WIGGINS REPORT}} = \frac{1260}{20 \times (8.4)^{1.5}} = 2.588$

THIS SEEMS LOW "C" SHOULD BE AROUND 2.7

USE $C = 2.7$

$Q = 2.7 \times 20 \times (8.6)^{1.5} = 1361.9$ CFS $\approx$ 1360 CFS

SURCHARGE STORAGE AVAILABLE = 967 ACRE-FEET

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT HYDRAULICS AND HYDROLOGY FILE NO.
SHEET NO. 3 OF 3 SHEETS
FOR GRIFFIN DAM
COMPUTED BY [illegible] DATE 5/19/78 CHECKED BY FFM DATE 5-22-78

	PMF	1/2 PMF	
PEAK FLOW (CFS)	9060	4530	
TIME OF HYDROGRAPH (HRS)	23.5	23.5	
$p = \frac{Q\ spillway}{Q\ peak\ inflow}$	.150	.300	← PERCENT OF PMF ABLE TO BE PASSED BY SPILLWAY NOT INCLUDING SURCHARGE STORAGE.
$1-p$	.850	.700	
STORAGE REQ'D (CFS-HRS)	90,486.75	37,259.25	
$= (1-p)\frac{Q_{peak\ in} \times Time}{2}$ (ACRE-FT)	7478	3079	
STORAGE AVAILABLE (ACRE-FT)	967	967	
STORAGE (REQ'D - AVAILABLE) (ACRE-FT)	6511	2112	

DETERMINE FLOOD ABLE TO BE PASSED USING REVERSE OF ABOVE METHOD.

STORAGE AVAILABLE = 967 ACRE-FT
= 11,700.7 CFS-HRS

$$\text{STORAGE REQ'D} = \text{STORAGE AVAILABLE} = (1-p)\frac{Q_{peak} \times Time}{2}$$

$$= \left(1 - \frac{Q_{spillway}}{Q_{peak}}\right) \times Q_{peak} \times \frac{Time}{2}$$

$$\frac{2 \times STORAGE}{Time} = Q_{peak} - Q_{spillway}$$

$$Q_{peak} = \frac{2 \times STORAGE}{T} + Q_{spillway}$$

$$= \frac{2 \times 11700.7\ \text{CFS-HRS}}{23.5\ \text{HRS}} + 1360\ \text{CFS}$$

$$= 2355.8\ \text{CFS}$$

WHICH IS $\frac{2355.8 \times 100}{9060} = \underline{\underline{26\%}}$ OF PMF

9315

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

GRIFFIN DAM

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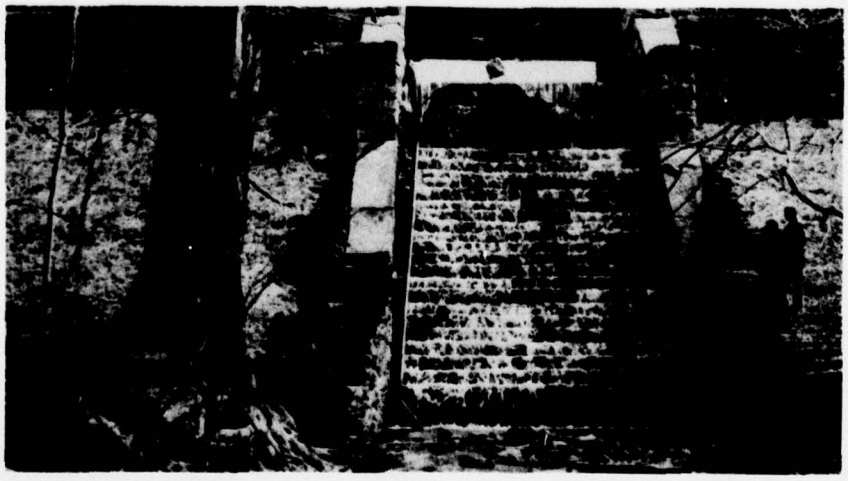
APPENDIX D

PHOTOGRAPHS

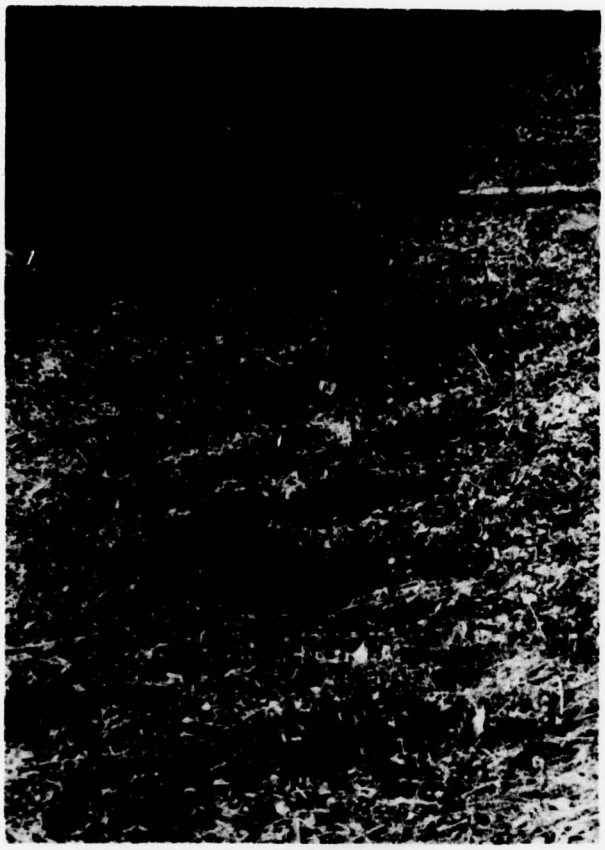
A. View from Left Abutment
Downstream Spillway Walls at Center
Wet Area on Right Abutment at Left of Photograph

B. View from Left Upstream Reservoir Shore
Spillway Bridge, Spillway Approach Channel,
and Masonry Intake Structure

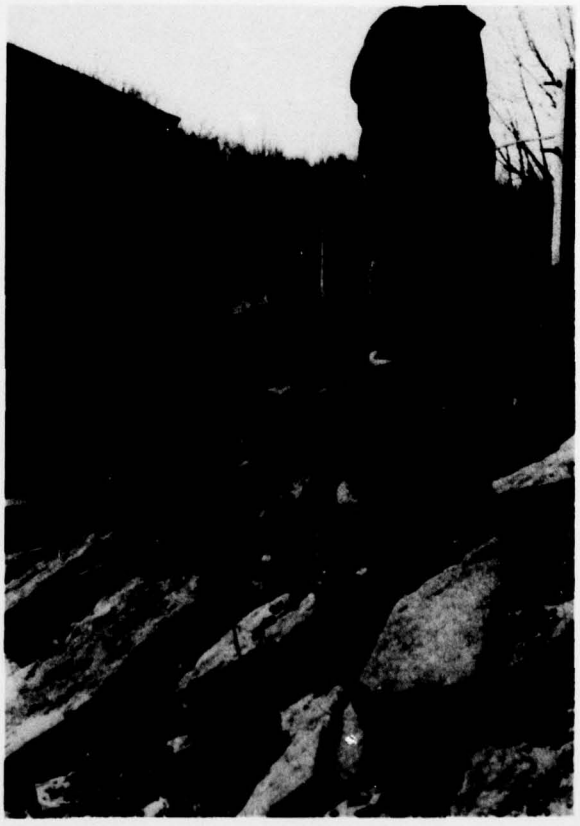
C. Downstream of Spillway Channel



D. Spillway Looking Upstream



E. Wet Area on Right Abutment
Vertical Sticks Approximately
Delineate Area



F.
Riprap on Upstream Slope

SUSQUEHANNA RIVER BASIN

LEGGETTS CREEK, LACKAWANNA COUNTY

PENNSYLVANIA

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APPENDIX E

GEOLOGY

GRIFFIN DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S 35°-40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a tortuous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch

Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. The horizontally stratified sandstone and shale formations of the Catskill group underlie the site of Griffin Dam. There are no records of any kind that would indicate the nature of the materials upon which the dam was constructed. Judging from the sandstone outcrops in the streambed and along the banks, it is believed that the masonry, or central, portion of the dam and spillway is founded upon a laminated and seamy gray sandstone. The masonry core walls, on either side of the central structure, are probably founded upon the same rock for, at least, a portion of their length. The overburden appears to be a relatively impervious mixture of silt, sand and clay, and is probably a combination of glacial till and decomposed red shale. Due to the horizontal nature of the apparent shale layer, the depth of overburden appears to be greater at the top of dam abutments than it is at the bottom contact with the sandstone formation.